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LAND REMOTE SENSING COMMERCIALIZATION ACT OF 1985

HEARING

BEFORE THE

SUBCOMMITTEE ON
SCIENCE, TECHNOLOGY, AND SPACE

OF THE

COMMITTEE ON COMMERCE,
SCIENCE, AND TRANSPORTATION
UNITED STATES SENATE

NINETY-NINTH CONGRESS

FIRST SESSION

ON

LAND REMOTE SENSING COMMERCIALIZATION ACT OF 1985

NOVEMBER 13, 1985

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LAND REMOTE SENSING COMMERCIALIZATION ACT OF 1984

WEDNESDAY, NOVEMBER 13, 1985

U.S. Senate,
Committee on Commerce, Science, and Transportation,
Subcommittee on Science, Technology, and Space,
Washington, D.C.

The subcommittee met, pursuant to notice, at 9:30 a.m. in Room SR-253, Russell Senate Office Building, Hon. Slade Gorton [chairman of the subcommittee] presiding.

Staff members assigned to this hearing: Charlie Faust, professional staff member and Marty Kress, minority professional staff member.

OPENING STATEMENT BY SENATOR GORTON

Senator Gorton. Good morning. Welcome to this hearing of the Senate Commerce Committee Subcommittee on Science, Technology, and Space. The purpose of this hearing is to discuss the implementation of the Land Remote-Sensing Commercialization Act of 1984, which provided a framework for the transfer of the Federal Government's LANDSAT system to the private sector.

The Commerce Committee has exercised vigorous oversight over LANDSAT commercialization since March of 1983, when President Reagan proposed to commercialize LANDSAT and the Government's weather satellite systems. This committee developed a resolution which passed the Senate expressing opposition to the proposed weather satellite transfer.

I introduced the resolution because I believe that the weather satellites support a critical Government mission, that of protecting public safety and welfare, and had no inherently commercial applications. I also felt that the furor over the proposed weather satellite transfer precluded any objective evaluation of the commercial potential of LANDSAT.

After the administration dropped the weather satellite commercialization proposal, I introduced legislation which became Public Law 98-365, the Land Remote-Sensing Commercialization Act of 1984. The act directed the Secretary of Commerce to evaluate private bids for operation of the existing LANDSAT system and for development and operation of a follow-on system, with the provision that the Federal Government could subsidize the development of a follow-on system.

The theory behind this phased transfer is that, although existing data markets would not support the costs of developing a remote sensing system, a private marketing effort might develop data markets sufficient to make remote sensing a profitable enterprise.

The applications of LANDSAT data in agriculture, forestry, cartography, and non-renewable resource exploration have significant commercial value. The act was intended to capitalize on this commercial value and to eliminate the need for more Federal spending on LANDSAT, which has amounted to over $1 billion.

Since the passage of the act, the Department of Commerce has signed a contract with the Earth Observation Satellite Company for the operation of the existing LANDSAT system and for development of a follow-on system. The cost to the Federal Government of the contract will be $295 million. The Congress already has authorized the entire $295 million sum and has appropriated $125 million.

This morning we will discuss the details of the contract and a number of related issues pertaining to the implementation of the act. Title IV directs the Department of Commerce to develop regulations to govern the operation of private remote sensing systems. The Department has circulated draft regulations for comment by interested parties and will finalize the regulations in the near future. We will discuss regulatory issues this morning.

Title V provides for continued Federal research and development in remote sensing technologies and applications. NOAA and NASA were directed to prepare a national plan for remote sensing research and development. Today we will discuss the status of this report and the future research priorities of the Federal Government and the user community.

Title VI provides for continued Federal archiving of remote sensing data. The act is intended to permit data from the archives to be available, especially for research, without undermining the market potential of private remote sensing systems. The subcommittee is interested in the views of Federal agencies, data users, and system operators on the subject of archiving policy.

Joining us today to discuss these issues are representatives of the Department of Commerce, the Department of the Interior, and NASA. We will also hear from the president of EOSAT and from representatives of various sectors of the data user community. We also expect several statements for our hearing record and we will hold the record open for statements from any interested parties.

We are delighted to have Senator Pressler with us. Senator, do you have an opening statement?

OPENING STATEMENT BY SENATOR PRESSLER

Senator PRESSLER. Yes. First of all, Mr. Chairman, I want to thank you for holding this hearing, because it is a very timely and important thing for our nation to review the direction we are going with the LANDSAT commercialization. LANDSAT commercialization is an extremely important issue to me, not only because it affects the EROS

Data Center in my State of South Dakota, but because it involves a technology that holds great promise for developing a better understanding and utilization of our global resources.

Since its origins less than 2 decades ago, LANDSAT has made great strides in solving land management problems and has led us to new discoveries in areas such as mineral and energy exploration, pollution control, natural disaster control, crop assessment, mapping techniques, famine relief, and a host of others.

But this entire system, indeed the entire concept of remote sensing, is still in its infancy. The potential for future applications is mind-boggling. The potential is one of the key issues I want to address today.

We have to continue with an aggressive research and development program in order to maintain our technological superiority in remote sensing. We have to explore and encourage new applications for these data. We have to make certain that data are available to all potential users on a nondiscriminatory basis. And we have to do this in an atmosphere that will assist and promote a strong commercial market.

The primary purpose of the 1984 LANDSAT Commercialization Act was to establish a framework and mechanisms for commercial marketing of LANDSAT data. The act transferred responsibility for development and operation of future land remote sensing satellite systems to the private sector. But equally important, it requires the Federal Government to maintain a strong role in programs of remote sensing research and development, including applications research.

This act also includes a requirement for long-term preservation through a central Federal archive which is located at the EROS—which will be located at the EROS Data Center near Sioux Falls of remotely sensed data. I am particularly interested in addressing the latter two issues, not only because I have had a heavy hand in drafting these provisions, but because I am convinced that they are essential to the long-term viability of this program.

The Department of Commerce and others involved in the contracting and licensing aspects of the commercialization process have done a tremendous job in its implementation. I know from personal experience how hard Dr. Calio, Dr. Bishop, and others have worked to make this process work. They are to be congratulated for their tireless efforts and a job well done.

Now that we have the contract signed and in place, I am interested in hearing how well it is working, and that is what we are here for today. But just as significantly, especially at this stage of the game, is charting a course for the implementation of the research and development, archive, and other required activities that were not included in the operative commercial contract.

We have been meeting with officials from EOSAT and the Departments of Commerce and Interior on these matters, and much of the groundwork for future implementation has already been laid. We are looking forward to an aggressive R&D program with strong university involvement. We have witnesses here today from the university community and we will be discussing their potential role in more detail later.

I am hopeful we can begin in the very near future to put together a university consortium to take advantage of the wealth of data stored in our national archive. The need for active university involvement is well documented in the legislation and recognized by the Federal agencies and other interested parties.

To ensure this type of activity, we must make certain that sufficient data can be acquired at non-prohibitive costs and that the research community has ready access to those data. At the same time, however, we need to strictly limit this access so it will enhance rather than harm the commercial operators market.

We must also establish and maintain a strong archive to support this research activity. A good archive will serve the research community as a good library serves scholars. We need to encourage an atmosphere conducive to a viable research and training program.

But much work remains, and I plan to follow through on each of these initiatives to make certain they become realities. This hearing serves as a good forum to begin crystallizing these ideas and begin open debate on these extremely important issues.

Again, I congratulate the Departments of Commerce and Interior, NASA, GEOSAT, and others on the excellent progress we have made thus far, and look forward to working with them as we continue to push forward in this very important area.

Thank you, Mr. Chairman.

Senator GORTON. Senator Trible?

Senator TRIBLE. I have no opening statement, Mr. Chairman. Thank you.

Senator GORTON. Thank you.

We do have statements for the record from Senators Hollings and Stennis, which will be included at this point in the record.

[The statements referred to follow:]

OPENING STATEMENT BY SENATOR HOLLINGS

Mr. Chairman, today this committee will review one of the first significant commercialization efforts undertaken by the Federal government in the civilian space program—the commercialization of the Federal land remote sensing satellite system (Landsat).

The focus of today's hearing will be the implementation of the Land Remote Sensing Commercialization Act of 1984 (Public Law 98-365). We will hear an accounting of what has been done and how, and what remains to be done and when. This hearing will also give "users" of the Landsat system a chance to voice their concerns with the new regime, and it will give researchers an opportunity to inform the committee about the effects of commercialization on ongoing and future remote sensing research and development activities.

Mr. Chairman, I don't think there was any member of this committee more pleased than I was at the signing of the Land Remote Sensing Commercialization Act of 1984. The signing of Public Law 98-365 brought to an end six years of acrimonious debate as to the "appropriateness" of privatizing Landsat. Its passage inferred that there was going to be a new way of doing business in the Federal Government, a more efficient and economical way.

One year later, the jury is still out on this process, primarily because it has taken more than a year to get EOSAT, the Hughes/RCA consortium and the final winner of competitive contacting process, out of the on-deck circle and up to the plate. The early reviews of this new way of doing business have not been favorable and have characterized it as costly, time consuming, and laden with uncertainty. If this is how things are going to be done, I am suspect about the potential for further commercialization or privatization of ongoing Federal activities.

Mr. Chairman, I hope that as a result of today's hearing, some of my concerns will be allayed and that Mr. Bishop and Mr. Williams will give this committee a candid and thorough accounting of what transpired during the course of negotiations and what were the principal sticking points.

I also hope to find that the commercialization of Landsat will not cause undue hardship on the user community or act as a deterrent to a sustained Federal program of remote sensing research and development. While I was supportive of the commercialization of Landsat, I did not see this action as the justification for terminating the Federal remote sensing research and development program.

I look forward to today's hearing and to the testimony of the distinguished witnesses. It is important that this oversight hearing provide the Committee with a thorough insight into implementation of the Land Remote Sensing Commercialization Act of 1984.

Thank you, Mr. Chairman.

STATEMENT OF HON. JOHN C. STENNIS, U.S. SENATOR FROM MISSISSIPPI

Mr. Chairman, first, let me thank you for holding these hearings and for your invitation to appear before the committee. These hearings address an extremely important new approach to using a very valuable new technology.

This approach to the commercialization of satellite information called for in the Land Remote Sensing Commercialization Act, Public Law 98-365, is a bold experiment which I believe will yield handsome benefits for the Nation. I have a special interest in this effort because my State of Mississippi will be a pioneer in the development of commercial products and services. In this regard, I am especially proud to introduce to you Dr. David Murphree, the President of the Mississippi Institute for Technology Development, who will testify at today's hearings. The Mississippi Institute for Technology Development is a private, non-profit corporation in Mississippi established to join the talent in our universities, in our government institutions, and private business in an effort to create new job-creating ventures in applied research.

One such venture is the National Center for the Commercial Development of Space Remote Sensing. This center was established as the result of successfully competing for a contract with NASA in their space commercialization program. The center will establish a partnership between industries, universities, NASA and other government organizations to support commercial applications. It is the purpose of this center to develop commercially profitable applications.

I am very proud that a Mississippi organization will have this opportunity to participate in the commercialization of this new technology. Dr. Murphree is putting together an energetic and creative team of scientists and technicians to join an exciting existing community of outstanding space scientists.

I want to commend you and the committee for your leadership in this field. You will have my support in this work, and I of course, respectfully request that the committee keep me informed of the progress made under this new legislation.

Senator GORTON. Our first panel consists of Dr. Bishop, Dr. Tilford, and Mr. Frederick. If they will step forward. And I need to inform them and the rest of the people here in the committee room today that the Senate will vote on cloture on the textile bill at approximately 10:00 o'clock, which will disrupt this hearing.

As a result and because we have some nine witnesses, we will ask each of these witnesses and the ones who follow them to limit their remarks to 5 minutes each. We have your written statements and they will be included in the record as if read in full. If you can summarize them for us under the circumstances today, we would be greatly appreciative.

With that, DR. Bishop, you are first on the list. You may proceed.

STATEMENTS OF DR. WILLIAM P. BISHOP, ACTING ASSISTANT ADMINISTRATOR FOR THE NATIONAL ENVIRONMENTAL SATELLITE, DATA, AND INFORMATION SERVICE, NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION, DEPARTMENT OF COMMERCE; DR. SHELBY G. TILFORD, DIRECTOR, EARTH SCIENCE AND APPLICATIONS DIVISION, OFFICE OF SPACE SCIENCE AND APPLICATIONS, NATIONAL AERONAUTICS AND SPACE ADMINISTRATION; AND DOYLE FREDERICK, ASSOCIATE DIRECTOR, U.S. GEOLOGICAL SURVEY; ACCOMPANIED BY ALLEN H. WATKINS, CHIEF, EROS DATA CENTER, SIOUX FALLS, SD

Dr. BISHOP. Thank you, Mr. Chairman and members of the committee.

I am entirely pleased to be here today. I am pleased not just to be here with supporters of the program, but pleased to be here after all the hard work by the Congress and the Administration over the last year to report that we have made some substantial progress, as both Senator Gorton and Senator Pressler said.

I will summarize my written remarks very briefly. Just a matter of introduction here. Titles II and III of the law provided that we sign a contract with private sector operators to operate the existing system and to provide a new system. That was done on the 27th of September with EOSAT. There are three parts to that contract: one that provides for the operation of LANDSAT 4 and 5; another part that provides for the development and delivery of two satellites in a ground system with slightly enhanced capabilities of both; and the third part that provides for the marketing by EOSAT of the data from all of the LANDSAT's.

I believe this contract meets the tests of the law regarding the non-discriminatory data access, national security, international obligations, and of course budgetary requirements.

Title IV of the act requires the Secretary of Commerce—and he has delegated that to NOAA—to license any private sector operator of a commercial system. Yesterday I approved the draft regulations for release to the Federal Register. They have been through the DOD and a lot of other interested parties for comments before their release to the Federal Register.

They will go to the Department of Commerce and OMB for approval. I do not expect much difficulty there. And then there will be 60 days for public comment. So we have a draft. Those regulations are largely procedural, because we feel the act laid out quite explicitly and quite well the substantive requirements.

Title IV requires a number of agencies, including the Department of Commerce, to carry forward an aggressive R&D program. We are considering a number of things, including a research institute jointly with the Department of Interior at the archive, some cooperative institutes with universities, working with NASA on a number of global science problems, and finally, working with NASA and other agencies on the polar platform of the Space Station as a major next step in remote sensing.

Title VI of the act, as both Senators Gorton and Pressler mentioned, required that the Secretary of Commerce establish a national archive. We have had discussions between NOAA and the USGS of the Department of the Interior and have reached an "in principle" agreement on how we will do that and who will do that.

And as Senator Pressler said, we decided that the EROS Data Center in Sioux Falls is an appropriate place for such an archive because it in principle already exists there. We will also reach some tentative agreements with SPOT Image on making data from SPOT available for our national archive, and later this week we will be working on the details for what.

Mr. Chairman, thank you for the opportunity of being here. I am available for questions now or later, at your pleasure.

[The statement follows:]

STATEMENT OF WILLIAM P. BISHOP, ACTING ASSISTANT ADMINISTRATOR FOR THE NATIONAL ENVIRONMENTAL SATELLITE, DATA, AND INFORMAITON SERVICE, NOAA

Mr. Chairman and Members of the Subcommittee, it is a pleasure to testify here today on the implementation of the Land Remote Sensing Commercialization Act, PL 98-365, by the Department of Commerce. We have made significant progress in all the key areas of the Act: the conclusion of a contract with the Earth Observations Satellite Company (EOSAT); the development of proposed regulations for licensing private remote sensing space systems; the development of plans for establishment of a national land remote sensing data archive in conjunction with the Department of the Interior; and our Earth science research efforts including preparation of the joint NOAA-NASA Remote Sensing Research and Development Report. I will briefly summarize each of these activities.

EOSAT CONTRACT

On September 27, 1985, the Department of Commerce and EOSAT (a joint venture partnership of RCA and Hughes Aircraft Company) signed a contract covering activities authorized by Titles II and III of Pub. L. No. 98-365. Under the Title II activities of the contract, EOSAT is to operate Landsats 4 and 5 for their anticipated lifetime at a cost to the Government similar to the Government's projected cost for such operation, and to market Landsat 1-5 data at EOSAT's expense.

Under the Title III portion of the contract, EOSAT, in return for the Government's payment of a fixed price of $250 million, is:

to design, develop and construct Landsats 6 and 7; to integrate and provide launch support for Landsats 6 and 7; and, to provide a ground system that will operate Landsats 6 and 7 and process data from these spacecraft;

to operate and maintain all aspects of the Landsat 6 and 7 systems, including any improvements that EOSAT may make, at EOSAT's expense;

to market the data from Landsats 6 and 7 at EOSAT's expense; and

to provide various technical and administrative reports, and 7 systems at EOSAT expense;

EOSAT will be entitled, from the date of the contract award, to all proceeds from the sale of Landsat data to private purchasers, foreign governments and federal agencies, as well as payments by foreign ground stations for access to data.

Satellite hardware will continue present capabilities with some significant improvements in sensor capability and life expectancy. Landsat 6 is scheduled for launch in December 1988, and Landsat 7 when Landsat 6 nears the end of its lifetime. Both launches will be on the shuttle and funded by NOAA.

In addition, there are special contract provisions related to limiting government liability under the contract up to the amounts obligated on the basis of the amounts appropriated and obligated form 1985/86 through 1989; EOSAT's obligations to honor existing memoranda of understanding with foreign ground stations; and EOSAT's right to terminate data marketing for the various spacecraft and operation of Landsat 6 and 7 based on EOSAT's accumulated revenues. EOSAT is required to provide data for the national remote sensing archive and to comply with national security requirements.

In light of the complexities of the Landsat program, I believe the contract is a major accomplishment.

LICENSING OF PRIVATE REMOTE SENSING SPACE SYSTEMS

Responsibility for implementation of the licensing provisions in Title IV of the Act has been delegated from the Secretary of Commerce to the Administrator of NOAA. During the past year, NOAA has drafted proposed regulations to establish the process for licensing operators of private land remote-sensing space systems under Title IV. These regulations will be submitted to OMB shortly. All the relevant Federal agencies and a number of Congressional staff members were consulted in the process of developing these regulations to ensure their consistency with ongoing activities and other related regulations (i.e., commercial launch vehicle licensing).

The Act itself sets forth detailed criteria for licensing decisions, and we found that, for the most part, further refinement by regulation would not be necessary or useful. In some cases where the Act is not specific, for example with respect to national security considerations, we found, after consultations with the Department of Defense, that further refinement was not feasible. Decisions are dictated by the current state of a technology which is changing rapidly and must be made on a case-by-case basis.

As a result, the regulations are essentially procedural. They set forth who must apply for a license, where to send an application, what information the application must contain, how Federal review will be coordinated, and how license conditions or restrictions will be enforced. The informational requirements are keyed to what we believe are the three major interests of the Act: preserving national security, fulfilling international obligations, and ensuring that unenhanced data generated by a licensed system will be distributed on a non-discriminatory basis. Essentially what is required is an adequate basis to make the required written findings that these interests are fully protected.

FUTURE FEDERAL RESEARCH AND DEVELOPMENT IN REMOTE SENSING

Title V of the Act directs the Secretary to conduct a continuing program of research in applications of remote sensing, monitoring of the Earth and its environment, and development of technology for such monitoring. In carrying out this provision, we are working closely with NASA in a number of areas including operation of our current satellite systems and data centers; development of the next generation satellites to continue our operational mission, including the research and development in both sensors and system and in data applications; and plans for exploiting the planned Space Station, specifically the polar platforms which we believe will provide exciting new capabilities and important efficiencies in operations for the nation.

NOAA also is looking at support for university research. We currently work with various cooperative institutes with major universities in atmospheric and ocean remote-sensing. In addition, we are working with the EROS Data Center near Sioux Falls, SD in its plans to establish a research institute co-located with the archive mandated by PL 98–365.

NATIONAL LAND REMOTE SENSING ARCHIVE

We are in the final stages of negotiating an agreement with the Department of the Interior, U.S. Geological Survey (USGS), to establish at the EROS Data Center the National Land Remote Sensing Archive as directed under Title VI of the Act. Dr. Calio, the NOAA Administrator, and Mr. Peck, the Director of USGS, met and agreed in principle on the archive plan. NOAA will continue to provide funding, with responsibility shifting over time, to USGS. NOAA and USGS will establish an advisory committee to assist in the definition of the basic data set and development of archival policies. NOAA has already had discussions with EOSAT regarding provision of data for the archive. The contract with EOSAT provides for Landsat data to be made available for the archive consistent with the Act. In addition, NOAA has had discussions with SPOT Image concerning provision of data from the French satellite system under similar conditions.

JOINT NASA/NOAA REPORT ON REMOTE SENSING RESEARCH AND DEVELOPMENT

Pursuant to Title V of the Act, NASA and NOAA are preparing a draft report on remote sensing research and development applied to the Earth and its environment. The report will be submitted to the Congress by January 31, 1986. In addition to NOAA and NASA, contributions were made and the report reviewed by the Departments of Agriculture, Defense, Energy, State, and the Interior, the National Science Foundation, and the Agency for International Development. The report represents the first major step in preparing a national plan for research and development in Earth (land, oceans, and atmosphere) remote sensing.

The report contains a discussion of:

the remote sensing missions of the Federal agencies;

the relationship between NASA and NOAA and between Government agencies and the private sector;

ongoing research and development in Earth remote sensing in the Federal Government;

the state of our knowledge of the Earth, gaps in our scientific understanding, and current limitations to our applications of remote sensing;

measurement objectives from space that would help fill the above gaps and limitations; and

proposed Earth remote-sensing plans of NASA and NOAA.

The next biennial report, due in July 1987, will contain the national plan for Earth remote sensing. It will be based upon analyses of material gathered for this report, definitions of Federal agency requirements, and the recommendations of the several national committees currently reviewing space-based Earth science and applications.

SUMMARY

In conclusion, since the enactment of P.L. 98-365, the Department of Commerce has moved to fulfill its new responsibilities. The past year has been a busy one. We laid the foundations for an exciting future—a future which includes the evolution of a viable commercial Landsat program, able to develop more fully the potential market around the world. Research and development will be required to maintain U.S. leadership in satellite remote sensing and earth observations. The Department of Commerce will work with industry and academia to achieve this goal.

Thank you for the opportunity to testify. This concludes my prepared statement. I would be pleased to answer any questions you might have.

Senator GORTON. Dr. Bishop, we thank you. And we will go forward now to Dr. Tilford.

Dr. TILFORD. Thank you, Mr. Chairman, members of the subcommittee.

I am pleased to be here today to discuss Public Law 98-365. As I understand it, the primary purpose of the act is intended to commercialize civil land remote sensing space systems, and that competition by the Government with such commercial operations should be avoided. It is also clear that it is the policy of the United States that civilian unenhanced remote sensing data should be made available to all potential users on a non-discriminatory basis.

The act also attempts to ensure that the Federal Government, in particular NASA and NOAA, will continue and enhance a comprehensive program of research and development of advanced remote sensing technology in order to improve and expand both the United States' capability for remote sensing from space and the application and utilization of such capabilities.

NASA is pursuing these intended purposes and policies of the act. We have recently completed, in a joint effort with NOAA, the final draft of elements that will lead to a comprehensive integrated national plan on research and development activities of the Federal agencies as required by title V of the act.

This first submission, however, does not yet contain the recommendations of the Earth System Science Committee, whose report will be available in 1986. Nor does it address the future interactions between the Federal Government and the private sector. This latter issue is being reviewed by the NASA Space Applications Advisory Committee and, hopefully, in the near future by the Space Applications Board of the National Research Council.

We have continued and enhanced the administration's program of remote sensing research and development, within available resources, and have been exploring potential cooperative arrangements with the private sector. In accordance with the provisions of section 501, we are undertaking major selected remote sensing research programs that are aimed at maintaining U.S. worldwide leadership in civil remote sensing.

The program includes sensor development, basic research, technique development and cooperative applications/research studies. Sensor development is focused on the development of the future generations of land observing systems, including the Shuttle Imaging Radar Program which uses area array detectors and an advanced imaging radar program for use on the shuttle and subsequently on the proposed polar orbiting platform component of the space station.

The techniques developed and validated by NASA-supported scientists will become, we believe, the routine methods for the sophisticated analysis of space observations in the 5 to 10-year time frame and will provide an enhanced commercial market for such data.

While we concur completely with the policies of the act, in pursuing these activities we have occasionally run into what appears to be inconsistencies in the provisions of the act. Under section 502 and 503 of the act, we have recently completed the sale of the Large Format Camera experimental data to Martel Laboratories of St. Petersburg, FL. Nevertheless, the provisions of section 502 as currently worded and interpreted hamper the Federal Government in providing access to experimental data to non-Government funded research and development and user communities in a timely fashion.

NASA believes that it is very important to all potential users of land remote sensing experimental data that the research and development community have an early opportunity to evaluate the quality and potential of such data. Such analysis typically requires a minimum of two to four years after the data become available to investigators.

The GEOSAT committee in particular has taken a position that data from experimental remote sensing programs are typically of an advanced type, with such limited coverage—for example, a single shuttle flight—that to consider them in competition with an owner-operator of the LANDSAT system is technologically inappropriate. It is interesting that in our efforts to sell the first set of experimental data under the act we received only one proposal, even though 26 companies had expressed interest originally.

In our exploration of cooperative research and development activities with the private sector under section 501 of the act, we have run into what we believe is an inconsistency between title V and some of the intended purposes and policies of the act. The definition of "nondiscriminatory basis" in section 104 states: "without preference, bias, or any other special arrangement, except on the basis of national security."

This takes into account the need for special arrangements based on national security concerns, but does not address the possibility for special arrangements to ensure the continuation of Federally funded research and development activities.

However, in section 501(a) NASA is directed to conduct such research and development in cooperation with other Federal agencies and with public and private research entities which will foster such cooperation. section 104 limits the scope of arrangements that we might enter into with the private sector if the data must be sold to all potential users, including the research and development partner, on a nondiscriminatory basis.

This also further complicates those international experiments where foreign partners are collaborating with us in instrument developments which result in combined data access to both parties.

We have embarked on a program that endeavored to implement the provisions of the act where NASA activities are concerned. However, we are concerned about the complexities involved in the release of experimental data to non-Government funded users and the potential limiting of research and development arrangements that can be made with a private sector system operator or an international partner based on the definition of "nondiscriminatory basis."

Thank you, Mr. Chairman. I will be pleased to attempt to answer any questions you might have.

[The statement follows:]

STATEMENT OF DR. SHELBY G. TILFORD, DIRECTOR, EARTH SCIENCE AND APPLICATIONS DIVISION, OFFICE OF SPACE SCIENCE AND APPLICATIONS, NASA

Mr. Chairman and members of the Subcommittee.

I appreciate the opportunity to appear before the Subcommittee today to review the implementation of the "Land Remote-Sensing Commercialization Act of 1984". NASA understands that the primary purpose of the Act is intended to commercialize civil land remote-sensing space systems that properly should be operated by the private sector and that competition by the Government with such commercial operations should be avoided. It is also clear that it is the policy of the United States that civilian unenhanced remote-sensing data should be made available to all potential users on a nondiscriminatory basis. The Act also attempts to ensure that the Federal Government (in particular NASA and NOAA) will continue and enhance a comprehensive program of research and development of advanced remote-sensing technology in order to improve and expand both the United States capabilities for remote-sensing from space and the application and utilization of such capabilities.

NASA is pursuing these intended purposes and policies of the Act. We have recently completed, in a joint effort with the Department of Commerce, the final draft of elements that will lead to a comprehensive integrated National plan on research and development activities of the Federal Agencies as required by Title V of the Act. This first submission, however, does not yet contain the recommendations of the Earth System Science Committee, whose overview report will be available in January 1986 and the final report in late 1986. This first joint report also does not treat the future interactions between the Federal Goverment and the the private sector. This latter issue is being reviewed by the NASA Space Applications Advisory Committee and, hopefully, in the near future by the Space Applications Board of the National Research Council. These issues and a comprehensive set of milestones will be incorporated into the next biennial report to be submitted in July 1987.

We have also recently released the first experimental data obtained since the passage of Public Law 98-365 (from the first shuttle flight of the Large Format Camera) to the private sector through the sale of the data "en bloc" through a competitive process. We have also continued and enhanced the Administration's programs of remote-sensing research and development, within available resources, and have been exploring potential cooperative arrangements with the private sector.

In accordance with the provisions of Section 501 (Title V, Research and Development) we are undertaking major selected remote-sensing research programs that are aimed at maintaining United States worldwide leadership in civil remote-sensing. These programs include basic research, development of new technologies and techniques and applications oriented investigations. We are currently conducting research in a wide variety of areas of relevance to the commercialization of the Landsat system. These activities are conducted under the Environmental Observations & Solid Earth programs. The program includes sensor development, basic research, technique development and cooperative applications/research studies.

Sensor development is focused on the development of the future generations of land observing systems. The Shuttle Imaging Spectrometer Experiment (SISEX) uses area array detectors to provide comprehensive spectral and spatial information. SISEX is planned to fly on the shuttle in 1991. Work continues on linear array solid state detectors which are also candidates for use on future Earth observing satellites.

We are also developing an advanced imaging radar for use on the shuttle and the proposed polar orbiting component of the space station. Other areas of activity include advanced laser radars (lidars) and digital topography using radar or lidar.

Precursor versions of the spacecraft instruments which operate from aircraft are used in ongoing research programs and to develop algorithms for use by the more advanced spaceborne instruments. We are also making extensive use of the operational weather and land remote-sensing satellites, often in conjunction with the experimental airborne sensors. In this arena there is a strong merging of the goals of basic research and applied studies. The techniques developed and validated by NASA supported scientists will become the routine methods for the sophisticated analysis of space observations in the five to ten year time frame. For example, the thematic mapper, with its 30 meter resolution, requires more sophisticated analysis methods to take advantage of the added information content of these observations.

NASA continues to engage in cooperative programs with private sector enterprises where appropriate. The increasingly sophisticated user community is prepared to assimilate the new analytical techniques and new sensors developed by NASA into their programs, often providing essential ground truth and regional expertise in return. We find this to be a most satisfactory way to conduct our programs.

While we concur completely with the policies in the Act, in pursuing these activities we have occasionally run into what appears to be inconsistencies in the provisions of the Act. We are also concerned about provisions that appear to restrict the ability of the Federal Government to permit data from experimental programs to be made available to the general public.

Under Sections 502 and 503 (Title V) of the Act, as indicated above, we have recently completed the sale of the Large Format Camera (LFC) experimental data to Martel Laboratories of St. Petersburg, FL. Martel will market the data worldwide on a nondiscriminatory basis. We recognize that Congress's main concern about the use of experimental data is based on avoiding competition with private sector activities and we concur with this policy. Nevertheless, the provisions of Section 502 as currently worded and interpreted, hamper the Federal Government in providing access to experimental data to the non-government funded research and development and user communities in a timely fashion. In some cases, these data may not have economic value. NASA believes that it is very important to all potential users of land remotely-sensed experimental data that the research and development community have an early opportunity to evaluate the quality and potential of such data.

Such experimental data typically requires a miniminum of two to four years after the data become available to the investigator to evaluate and understand the potential for such data. The GEOSAT Committee in particular has taken a position that data from experimental remote-sensing programs are typically of an advanced type, with such limited coverage(one flight on the shuttle), that to consider them in competition with an owner/operator of the Landsat system is technologically inappropriate. They further feel that it is important for the knowledgeable end-user community to assess the potential use of the experimental data as an important step in evaluating the ongoing development of satellite remote-sensing. The provisions of Sections 502 and 503, of course, go far beyond the Landsat system. It is interesting, however, that in our efforts to sell the first set of experimental data under the Act we received only one proposal even though 26 companies had expressed an interest. The one proposal was submitted by Martel Laboratories. It was responsive and valid, but had a very low price ($100) for the film.

The indications are that Martel was uncertain about the commerical value of the experimental film data because of the limited coverage, the up-front investment required, no completed evaluations of the quality of the data; and the fact that the Government had already established a low price for the film products and had eroded the market to some degree in releasing it to cooperative experimenters through the EROS Data Center. NASA has instituted a policy that such data will be made available only to Federal Goverment funded research efforts and that such data cannot be used or reproduced for any commercial applications. The EROS Data Center, however, has provided these data to any researcher requesting such data, at cost, with the provision that these data will not be used for any commercial application. It is probable that elements of Martel's concerns will apply to other experimental data.

In our exploration of cooperative research and development activities with the private sector under Section 501 (Title V) of the Act we have run into what we believe is an inconsistency between the Title V and some of the intended purposes and policies of the Act. The definition of "nondiscriminatory basis" in Section 104 (DEFINITIONS) states "... "without preference, bias, or anyother special arrangement (except on the basis of national security)...". this takes into account the need for special arrangements based on national security concerns, but does not address the possibility for special arrangements to ensure the continuation of Federally funded research and development activities. However, in Section 501(C) NASA is directed to conduct such research and development in cooperation with other Federal Agencies and with public and private research entities (including private industry, universities, State and local governments, foreign governments, and international organizations) and to enter into arrangements (including joint ventures) which will foster such cooperation. But Section 104 limits the scope of arrangements that we might enter into with the private sector if the data must be sold to all potential users including the research and development partner on a nondiscriminatory basis. This also further complicates international experiments where foreign partners are collaborating with us in instrument development which results in combined data access for both parties. In these cases both sides would be expecting to have these research data sets available to investigators in the United States and abroad and to the general user community. In future NASA remote-sensing activities from Shuttle flights, and the Space Station polar platform, we anticipate difficulties in the distribution of experimental data.

In conclusion, Mr. Chairman, NASA believes that the purposes and policies of the "Land Remote-Sensing Commercialization Act of 1984" are very clear, as in the mandate under Title V, but there is an inconsistency. We have embarked on programs that endeavor to implement the provisions of the Act where NASA activities are concerned. We are concerned about the complexities involved in the release of experimental data to non-government funded users and the potential limiting of research and development arrangements that can be made with a private sector system operator or an international partner based on the definition of "nondiscriminatory basis".

Thank you Mr. Chairman. I will now be pleased to answer any questions the Subcommittee may wish to ask.

QUESTIONS OF THE MINORITY AND THE ANSWERS

Land Remote Sensing Commercialization Act

Question 1: Could you please give NASA's view of the definition of roles and responsibilities for remote sensing research and development as specified by the Act? How does NASA carry out this section?

Answer 1: In NASA's view, the Act is very clear in directing the Administrator of NASA to continue to enhance remote sensing research and development. The Act specifies that we will conduct experimental space remote sensing programs, develop remote sensing technologies and techniques, and conduct such research and development in cooperation with other Federal agencies and with public and private research entities. The Secretary of Commerce is directed to conduct a continuing program into research in applications of remote sensing, monitoring of the Earth and its environment and the development of technology for such monitoring. In addition, other Federal agencies are authorized and encouraged to conduct research and development on the use of remote sensing in fullfilment of their missions.

In accordance with the provisions of the Act, NASA is undertaking major selected remote sensing research programs aimed at maintaining United States worldwide leadership in remote sensing. These programs include basic research, development of new technologies and applications oriented programs. This is accomplished primarily through our land processes program that seeks to understand the state of the Earth's surface, its variation with time, and the processes that control these variations.

These research activities are carried out by NASA and university scientists working under the guidance of discipline oriented programs. The research areas are geology, hydrology, biogeochemical cycles and remote sensing science. Program planning is carried out by panels of NASA and university scientists under the direction of NASA managers and in coordination with the National Academy of Science and the NASA Advisory Council. Research is subjected to rigorous peer review prior to initiation. While the NASA staff has considerable expertise in these wide ranging areas, the breadth and diversity of the university community is particularly important to the long term success of the program.

The link between scientific research and applications is maintained through a continuing dialog with current non-government users as well as those segments of the government which are involved in applied uses of the data. Current examples include a laser altimeter study of forest timber volume and biomass, development of techniques for identification of mineral species, development of techniques for digital topographic mapping with synthetic aperture radar, and development of methods to estimate the productivity and carrying capacity of pastoral ecosystems such as the African Sahel. Strong links and cooperative programs are maintained with international bodies such as the Food and Agriculture Organization (FAO), the United Nations Environment Program (UNEP), the World Meteorological Organization (WMO) and the World Bank.

Question 2: In your statement, you provide an accounting of the sale of the Large Format Camera experimental data. Based on your experience with this sale, should the distribution and sale of experimental data receive different treatment? Could this be done in such a manner to avoid competition with EOSAT? Traditionally, how did NASA distribute "experimental data"?

Answer 2: We believe that the distribution and sale of experimental data should receive different treatment than that provided by the Act. We also believe that this can be done in such a manner as to avoid competition with EOSAT. The very nature of experimental data with its limited coverage, uncertain quality, and normal distribution to government sponsored researchers appears to limit its commercial value.

Prior to the Act, NASA distributed experimental data through two sources. One of these was through the EROS Data Center (EDC) in Sioux Falls, South Dakota. All experimental Landsat data and aerial photography, for instance, was distributed through EDC. Data of a pure scientific nature was distributed through the National Space Science Data Center at the Goddard Space Flight Center.

Question 3: A basic assumption of the Act is that there will be a continued Federal remote sensing R&D program. As a matter of fact, the Committee anxiously awaits the National Plan for Remote Sensing R&D and hopes the final submission significantly improves upon the quality of the original draft.

How does NASA intend to comply with the R&D mandate included in the Act? Does NASA intend to do "generic instrument research" or specific instrument research? How does NASA propose to insure the transfer of new remote sensing technologies to the commercial sector?

Has EOSAT ever approached NASA with a remote sensing R&D shopping list? With the termination of the multi-linear array (MLA) program, is the remote sensing industry facing a possible technology gap as well as a data gap?

Answer 3: NASA is continuing its research and development programs in remote sensing. Our program encompasses technology development, basic research and analytic technique development. For example, the Spaceborne Imaging Radar Program encompasses all of the above listed elements in that the program is developing distributed array technology, advancing basic research in understanding microwave remote sensing and expanding the scientific use of these sensors through techniques and applications oriented investigations. Similarly, in the visible areas of the spectrum, we have initiated multiple remote sensing development programs including laser radars (lidars) and two major programs involving the development of a sensor using advanced area arrays of detectors while continuing to support the technology development and testing of linear arrays.

In the area of instrument research, NASA is conducting both generic and specific instrument research. I believe the basic research being conducted to develop and demonstrate a short wave infrared linear array is generic to land remote sensing (especially applicable to Landsat type sensors) while our instrument development under the SISEX effort is aimed at providing a scientific research tool which can evolve into an R&D instrument for the Space Station polar platform. In fact, the basic techniques and technologies being developed could be applied to a variety of tailored instrument designs.

To effect the transfer of NASA developed technology, the Office of Commercial Programs has been established. One of its missions is to provide assistance in the commercialization of NASA developed technologies. Perhaps the most signficant contribution by the Earth Science and Applications Division will be the development and demonstration of the use of the variety of remote sensing systems currently underway within our programs.

EOSAT has approached NASA with suggestions for cooperative instrument development and with a description of an Advanced Landsat System which requires some R&D in focal planes and spectral filter design and fabrication. We are currently studying the cooperative venture proposal. In addition, we are expecting a comprehensive review of and recommendation for the future interactions between the Federal Government and the private sector to be provided by the NASA Space Applications Advisory Committee and hopefully in the near future by the Space Applications Board of the National Research Council.

NASA has terminated its development of a Shuttle instrument based on an MLA focal plane. We are continuing the development of the linear array technology and expect to begin testing some devices in FY 86. In addition to the linear array development, we are actively developing the next generation of electro-optical detectors, i.e., the area arrays for use in an imaging spectrometer. Based on the successful demonstration of these two technologies, the U.S. remote sensing commercial sector will have technology available to it which exceeds that possessed by any of its foreign competitors.

Question 4: At this point in time, can NASA specify any required technical amendments that could improve implementation of the Act, minimize any adverse effect on the research community, as well as facilitate commercialization? In what ways, if any, has the Act affected NASA's Space Station negotiations or remote sensing applications in the Shuttle?

Answer 4: The following are provisions of the Act that NASA believes would be improved by technical amendments. The definition of "non-discriminatory basis" in section 104(3)(A) does not address the need for special arrangements to ensure continuation of federally funded research and development activities which are a major part of the Act. This is inconsistent with provisions of Title V and can be alleviated by inserting at the third line of 104(3)(A) after "section 607" the following phrase: "or federally funded research and development activities." As currently written, section 502 hampers the Federal government in providing access to experimental data. This problem can be easily corrected by changing the "or" in the next to the last sentence in section 502 to "and". Lastly, the provision of section 603 concerning the prohibition against reproduction or dissemination of unenhanced data by the purchaser may impact the publication of articles containing unenhanced data in scientific journals and government technical reports. In this case it should be made clear that this section does not apply to Title V.

NASA's Space Station negotiations are in such an early stage that the potential impact of the Act on these negotiations has not been assessed. The potential impact of the Act on remote sensing applications of the Shuttle is largely associated with distribution of experimental data and with possible international complications where foreign partners are collaborating with us in instrument development but combined data sets must be handled on a non-discriminatory basis.

Question 5: Based on the proposed EOSAT rate structure, what will be the effect on NASA's acquisition of Landsat data? What is the current NASA budget for the data acquisition? How will the reduction in available data to NASA affect NASA researchers?

Answer 5: The EOSAT rate structure will have a major impact on NASA's acquisition of Landsat data. The Thematic Mapper Investigators program was set up through an Announcement of Opportunity process in 1984. The program was designed to complete our understanding of the value and importance of the thematic mapper data and to assist in our planning and design of future remote sensing systems. At the present time, based on the data costs agreed to earlier by NOAA, there is approximately $250,000 available to acquire the remaining 700 Landsat scenes required by the investigators. The EOSAT rate structure, however, would require $3.5 million in data acquisition costs to maintain the current program. Since the Principal Investigators have been selected and funded and there are no additional dollars available in the current NASA budget for increased data costs, we are currently looking at how to reduce this important investigations program to one tenth of the investigators originally selected. This will reduce the objectives of the program and its value to future programs. We expect that such reductions will also impact the development of future commercial markets for remotely sensed data.

Question 6: Several witnesses have identified the importance of remote sensing applications research. What activities are currently planned in this area by NASA? What future applications research will be pursued by NASA? Does the emergence of a commercial remote sensing industry negate the need for Federal government applications research?

Answer 6: NASA is continuing a vigorous research and analysis program in the area of Earth remote sensing. While the major thrust of this program is in support of NASA's scientific study of the Earth as a coupled land-ocean-atmospheric system, much of the work is of potential benefit to future applications. The successes of the past applications oriented studies are demonstrated by the existence of a strong and continuing demand for satellite data for operational government programs and the viability of the "value added" private organizations. NASA supported efforts will address the most challenging aspects of utilization of satellite data such as high spectral and spatial resolution visible and infrared observations, bidirectional reflectance observations and multi-sensor observation using radar and optical systems and sophisticated computer models. NASA is currently conducting research in sensor development, technique development and cooperative applications/research studies. The major disciplinary areas involved are terrestrial ecosystems, hydrology and geology. The current program extensively uses Landsat data and NOAA operational satellite sensors as well as data from airborne sensors and experimental sensors flown on the Shuttle. In this broad program the term applications research is not assigned to a particular element but is a diffused effort throughout the program.

Future applications research will be aimed at establishing new and improved techniques to meet the measurement objectives from space that specifically address a knowledge gap here on Earth. NASA's program will include the following instrument categories: passive, including imaging (visible/infrared, microwave, and radiation budget) sensor and sounder; active, including microwave sensors and lasers; and magnetic/gravity sensors. In addition, we must develop the capabilities to efficiently handle, interpret and apply the large volumes of data that will be derived from future remote sensing satellite programs.

In recognition of the importance of remote sensing applications research, the Office of Commercial Programs at NASA has recently awarded a grant to the Institute for Technology Development to establish a Center for the Commercial Development of Space Remote Sensing. The objective of this Center is to stimulate high technology remote sensing research of commercial interest. It is intended that this research will eventually lead to the development of new products and/or processes which will either have commercial potential or contribute to possible new commercial ventures and will enhance the market demand for remotely sensed data.

In view of the above, it is clear that the need for Federal goverment applications research is not negated by the emergence of a commercial remote-sensing industry.

Senator GORTON. Thank you, Dr. Tilford.

Mr. Frederick.

Mr. FREDERICK. Mr. Chairman, members of the committee:

I am pleased to be here to talk about the Department of the Interior and the U.S. Geological Survey role in remote sensing, and especially those activities relating to Public Law 98-365.

I have with me today Mr. Allen Watkins, who is the Chief of our EROS Data Center in Sioux Falls, SD, the principal activity of the U.S. Geological Survey involved.

Senator GORTON. We would be happy to have him make a brief statement, too.

Mr. FREDERICK. The U.S. Geological Survey has been involved in the LANDSAT program both as a user for its applications and as a partner in the distribution of data, early on with NASA and subsequently with NOAA. We continue to be involved in the remote sensing aspects, from the point of view of research in the applications and as it relates to geology, hydrology, cartography, and other earth science aspects.

We also are involved in the data distribution, not only of the LANDSAT material but other satellite and aircraft data, out of our Sioux Falls, SD, facility. It might be helpful for the committee just to review the capabilities at EROS Data Center, to put into perspective some of the activities that we will talk about in just a few minutes.

Out of the EROS Data Center, we do archive and distribute aircraft data as well as LANDSAT data. Aircraft data distribution is a substantial part of our responsibilities for archive data distribution. That includes USGS mapping photography, photography from the National High Altitude Photography Program, synthetic aperture radar data, as well as other information, both operational and experimental.

The EROS Data Center, as well as other parts of the Geological Survey, is involved in remote sensing applications research, both in terms of the taking end of the business as well as the analytical tools for the use of remote-sensing data, along with other information required for land remote-sensing kinds of decisionmaking—management of surface, the agricultural aspects, as well as geology and hydrology.

We most recently are involved at the EROS Data Center, as well as other parts of the Geological Survey, in specifically looking at the possibility of combining the earth remote sensing data with digital cartographic data for specific decisionmaking.

We have made the decision recently to place our digital cartographic sales data base at Sioux Falls. We think that they are the appropriate organization and it will combine these data with other information, for an essential data base for decisionmaking.

The other parts of the Geological Survey, our National Mapping Division, Water Resources Division, and Geologic Division, are also involved in the research and applications end of remote sensing; specifically, for use by our scientists and our operating program components.

We also represent the Department of the Interior in the whole area of remote-sensing coordination and digital cartographic data coordination to assure that the data is readily available for the decisionmakers throughout the Department of the Interior and the other civilian Federal agencies.

Now, specifically with respect to the implementation of the Land Remote Sensing Commercialization Act, we are involved in several components. Bill Bishop, a few minutes ago, mentioned the data archive and the research component. In addition to those, we do have an agreement with NOAA and EOSAT for continued support of the archiving and distribution of the LANDSAT data until such time as EOSAT has established their own processing and distribution capability.

Presently, we are completing an MOU with NOAA for that purpose. NOAA will provide overall management policy. We will work with EOSAT on a day-to-day basis to assure that the distribution continues uninterrupted.

As far as the archives are concerned, we have a tentative agreement with NOAA for establishing that archive at the EROS Data Center. Yet to be completed, would be the concept for operating policy, for data—the types of data to be included and the like.

For the research part, we are inclined and talking to NOAA about establishing a research component at the EROS Data Center, colocated with the archive. It will involve our own researchers and we would expect that NOAA would include some of their own research capability.

We specifically are concerned about making sure that industry, the academic community and State and Federal agencies, are involved in that process.

That agreement is under consideration at the moment.

In a related matter, we are talking about including the capability—at least we are exploring the feasibility of including at the EROS Data Center the capability—to handle the advanced high resolution radiometry data as a complement to the LANDSAT.

Mr. Chairman, that finishes my brief statement.

[The statement follows:]

STATEMENT OF DOYLE G. FREDERICK, ASSOCIATE DIRECTOR, U.S. GEOLOGICAL SURVEY

Mr. Chairman, I am pleased to be here to discuss the activities of the U.S. Geological Survey (USGS) and the Department of the Interior (DOI) as they relate to the Land Remote-Sensing Commercialization Act of 1984.

The Geological Survey has long been a user of remotely sensed data in its programs, and has played a significant role in the commercialization process. The Act requires the Secretary of Commerce to establish a data archive and calls for continued research and development by Federal agencies, including the USGS. To assist in meeting these requirements, the USGS will continue its role in the future development of remote-sensing technology.

The USGS and DOI were among the first to recognize the potential of satellite land remote sensing (Landsat). We have contributed to the program by recommending improvements to Landsat instruments, by producing and distributing data, by training numerous scientists inside and outside the Government in the uses of remote sensing, and by using remote sensing in our research and operational programs. For these purposes, we created the Earth Resources Observation Systems (EROS) program in 1966 and established the EROS Data Center in Sioux Falls, South Dakota, in 1971.

We continue to be vitally interested in remote sensing, because its use helps the Department and the USGS to be more efficient and knowledgeable in doing its jobs of managing the Nation's resources, understanding natural processes that affect the land, and understanding natural hazards and helping to mitigate their effects. It is also an invaluable tool in providing the Nation with basic sources of information such as planimetric and thematic maps.

The excellent capabilities of currently available remote-sensing instruments present a challenge to the earth-science community in the Government, the private sector, and academia. This challenge, to make full interpretation of the rich information content of the data, has not yet been fully met; and research within the earth-science community will continue. We also note that recent developments in computer technology have put enormous processing power within the reach of many more people; therefore, the potential for remote sensing to benefit the Nation is at an all-time high, and can be expected to continue to increase. These developments make the challenges in the arena of interpretive research even more important.

The interests and involvement of the USGS and the DOI in the progress of remote sensing complements those of the National Oceanic and Atmospheric Administration (NOAA). Just as we have found remote sensing to be a valuable source of information for studying and managing the land, NOAA has found it to be valuable for providing the Nation with information about the oceans and atmosphere. Our mutual interest has forged a strong partnership in continuing the development of remote sensing, and in maximizing the benefit derived from the Nation's investment in remote-sensing systems. This partnership will continue during the commercialization process.

We plan to fully support NOAA and EOSAT through the EROS Data Center during the 2 to 3 year period of transition from Federal to private operation of the Landsat system, in order to guarantee uninterrupted access to Landsat products until EOSAT has its data processing and distribution system operating.

The Commercialization Act calls for the Secretary of Commerce to establish a national archive of land remote-sensing data. NOAA and USGS are working together in planning the most cost-effective and most useful national archive possible. The archive represents a rich resource for earth scientists, just as a good library does. USGS and NOAA both consider it important that the archive be put to the fullest possible use in the most cost-efficient manner in order to realize the maximum benefit obtainable from the Nation's investment in developing the technology and purchasing the archive data.

It has been the experience of many Federal agencies that effective operation of a high-quality archive depends on the intimate involvement of researchers who demand excellence from it. Therefore, we are discussing with NOAA the possibility of establishing a program that would be specifically linked to the archive; it would simultaneously advance our research objectives and help to guarantee the health of the archive.

We are also discussing with NOAA and other Federal agencies the needs for repetitive remotely sensed coverage of the United States and the rest of the world to be acquired for the archive. Emphasis would be placed on monitoring areas where natural processes and the impact of man have significantly altered the earth's surface. The sub-Saharan region of Africa is a specific example; access to a record of desertification may contribute to avoidance or amelioration of such problems in the future.

USGS and NOAA are presently developing a Memorandum of Understanding to start the operation of the archive, by defining procedures for selecting data for purchase. Plans are also being made to place a core group of each agency's research staff at the archive. We also anticipate involving other researchers, both government and non-government, in research activities.

We consider it exceptionally important to involve the broadest possible community in research to maximize the ability to the archive. We recognize that there are potential tensions between widespread access to the archive's data and EOSAT's commericial interests, but we feel that we can construct full research access to the archive in such a way that EOSAT's data sales will actually be enhanced, through development of a larger user community. We want to express our appreciation to EOSAT for consulting freely with NOAA and USGS in this matter.

The USGS is also working with NOAA to study the feasibility of establishing a capability at the EROS Data Cener to receive and process data from NOAA's polar-orbiting Advanced Very High Resolution Radiometer (AVHRR). This capability could provide geographically referenced AVHRR data within hours after satellite overpass to support operational land-management and other earth-science programs. This would relieve excessive demands placed on existing NOAA/AVHRR reception and processing systems. These data could also be added to the national archive, providing yet another important type of remotely sensed data for global monitoring and resource assessment, and would provide coverage at much more frequent intervals than does Landsat. It is important to note that establishment of this activity could be carried out within available funds under current authority.

In summary, I have presented a brief overview of the USGS participation in carrying out the Federal Government's responsibilities specified in the Land Remote-Sensing Commercialization Act. We look forward to increased cooperation and participation with NOAA and will continue to work closely with EOSAT during the Landsat program transition. The Geological Survey and the Department of the Interior will continue to be major users of satellite remotely sensed data.

This concludes my prepared statement. I would be pleased to respond to any questions you may have.

Senator GORTON. Thank you.

Mr. Watkins, would you like to add anything or make a statement of your own.

Mr. WATKINS. Mr. Chairman, I am pleased to be here and I have no formal statement in addition to Mr. Frederick's.

Senator GORTON. All right. Thank you all very, very much, each of you for being here.

Dr. Bishop, can you give us an update on the condition of LANDSAT 5 and on the likelihood that it will function beyond its expected or predicted lifetime to March of 1987?

Dr. BISHOP. Certainly, Mr. Chairman. I am happy to do that.

LANDSAT 5, if I might be allowed to knock on wood, has been performing like a champ. The only thing that has failed on that satellite since its launch is one S-band transponder and there is a redundant transponder. And the only effect of that failure has been a slight dislocation in when we can provide simultaneously what we call housekeeping data from the spacecraft and the thematic mapper data to foreign ground stations. That will be solved early next year. That is just a matter of putting some new software into the spacecraft.

If I may be allowed to speculate on its future—and that is all I can do is specuate—if we look at the experience we have had with the polar orbiting weather satellites and examine a healthy satellite that survives the occasional infant mortality problems, such a satellite will usually survive longer than its design life.

If that is the case, then there is a reasonable probability that this satellite, LANDSAT 5, will survive longer than its design life of 1987.

Senator GORTON. If that turns out to be the case, would you delay LANDSAT 5?

Dr. BISHOP. Delay LANDSAT 6, do you mean?

Senator GORTON. Excuse me. LANDSAT 6.

Dr. BISHOP. That would be allowed under the contract. EOSAT is required under the contract to have the satellite ready for launch, but not necessarily to launch it. And so we can work together with EOSAT on that scheduling.

I suspect EOSAT will want the new capabilities in orbit as soon as possible, but you would have to ask Chuck Williams that.

Senator GORTON. You mentioned that the Department has circulated the draft regulations under title IV. What issues have been raised during the comment process, and does the Department believe that the final regulations will satisfy everyone who is intimately interested?

Dr. BISHOP. To my knowledge, no serious issues were raised by any of the parties who commented on it. There are a number of minor issues raised. One thing that we discovered during that process was that we could not specify in the regulations the conditions for meeting national security tests as specified under the law because the DOD assures us that this is a dynamic thing, and they need to see the individual proposals individually and, on a case-by-case basis, judge that they meet the national security requirements.

Beyond that issue, I don't remember a serious one during that comment. The regulations will be almost entirely procedural—where to send your application and what it should contain, and how we will make our findings.

Senator GORTON. The authority granted the Secretary by the act applies to system operators under the jurisdiction or control of the United States. How has the Department defined the U.S. jurisdiction, and have any objections to that definition been raised?

Dr. BISHOP. We have defined them using—I am not a lawyer, so the terms of art are a little uncertain in my mind—but using the concept of any one who receives substantial benefit under U.S. law is under the jurisidiction and control of the United States.

We then used several examples in the regulations to articulate exactly what this means. Clearly, someone who is launched by a U.S. carrier that does all of his operation, both controlling of the spacecraft and data management, outside the United States is outside the jurisdiction and control of the United States. There would be no way of enforcing any of the provisions of the law outside the United States.

Just as clearly, someone who was launched—no matter how—but does a satellite operation from U.S. soil or has a substantial marketing effort on U.S. soil is receiving the advantages and protection of U.S. law and is under the jurisdiction and control of the United States.

There is, of course, a gray area that would have to be judged on a case-by-case basis and the regulations invite parties who might be interested to get a binding ruling from the administrator of NOAA as to whether they require a license.

Senator GORTON. There have not been any complaints about your definitions to this point?

Dr. BISHOP. I don't think there have been any in writing. I have heard one informally and I think we have probably taken care of it.

Senator GORTON. The act requires that all system operators make data available on a nondiscriminatory basis. In that connection, has the Department refined the act's definition of nondiscriminatory access to the point at which system operators will know what terms of data availability are or are not legal?

Dr. BISHOP. We read the law carefully and found the definition in the law quite adequate for our purposes, and so we did not expand on that.

Senator GORTON. How is the Department going to enforce them?

Dr. BISHOP. Well, the law gave the Secretary considerable enforcement powers ranging from modification of a license, to removal of the license, to a rather substantial fine if the violation is continued for many days. And all of these tools will be available to us.

Senator GORTON. Will foreign system operators also provide nondiscriminatory access to data? And, if not, what will the effect be on the commercial viability of systems like EOSAT which must do so?

Dr. BISHOP. The one foreign operator, SPOT, and their subsidiary for marketing, SPOT Image, have told the world that they will make the data available on a nondiscriminatory basis. And they have done that in writing to us at NOAA in the course of discussing some parts that they obtained from NASA.

So they have made a firm commitment to do that. I cannot speak for any of the others. The Japanese are still considering it.

And would it have an impact on the commercial endeavor? It could, but I have not constructed in my own mind a scenario which would have a major impact. Perhaps Chuck Williams would also be a useful witness on that.

Senator GORTON. Public Law 98-365 requires NOAA and NASA to submit to a joint national plan for remote sensing. You mentioned that the plan will be completed next year.

What research in remote sensing technologies and applications does NOAA believe that the Federal Government should undertake, pending the availability of funds in the next 5 to 10 years?

Dr. BISHOP. Mr. Chairman, I think there are three areas of research. I think there is a broad base among the agencies for carrying out those areas. The first is in advancing technology, and that has traditionally been a NASA role, and they have a technology program.

The second is research in applications, and there are several agencies, three of them represented here at the table, who have a strong interest in that. But there are others like the Department of Agriculture who also have a strong interest and, I might add, several agencies in the Department of Defense.

All of those, I believe, will be carrying forward their own particular applications research, and there is a substantial support for the university community there.

The third area is in basic earth sciences, and a number of the agencies have been discussing together a major thrust in a forum provided by the Office of Science and Technology Policy and several other fora, like the Earth Systems Sciences Committee that Dr. Tilford referred to. I won't say a budget initiative, because a lot of it may be done under present budget initiatives, but a major thrust in the area of global earth sciences.

Those three areas, I think, ought to be carried forward.

Senator GORTON. Will the plan address ocean remote sensing?

Dr. BISHOP. It certainly will. It is one of the three major components. There is atmospheric remote sensing, (largely for weather purposes, but atmospheric) oceanographic and land remote sensing. All three are addressed uniformly, I believe.

Senator GORTON. We are going to have to recess this hearing, and will start as soon as we are able to do so.

[Recess.]

Senator PRESSLER (presiding). I will call this meeting back to order. I have some questions to address to the panel, so if everyone could take their seat, we will resume.

Senator Gorton has asked me to resume the hearing at this point. I will address this question to the entire panel. Could you address the need for and benefits of strong university involvement in R&D programs, specifically commenting on the desirability of a university consortium any other roles in which universities could participate?

Dr. Bishop, and go right across if you wish.

Dr. BISHOP. Okay. Thank you, Senator Pressler.

I personaly believe, and I think it is a corporate belief of NOAA, that a strong university connection in R&D is very important for us as an agency and for the country. We have had and I would list two mechanisms. We have had one mechanism that has been particularly useful in the weather satellite arena. That is something we call a cooperative institute where NOAA places a small unit of employees at a university, in a university environment. And these are researchers, along with a contingent of university researchers, and together they comprise and institute focusing on the peculiar problems of satellite meteorology or satellite oceanography or, hopefully in the future, satellite remote sensing of land surfaces.

And this is one mechanism for which I have been a proponent for some years, and we have seen substantial success.

A second mechanism is one that we have been talking with USGS about, which is a consortium of universities dealing with the large data bases, and that is something that perhaps I can ask my colleagues to talk about a little later, but it is something that we think is a uniquely fine idea for a large data base.

In any case, it is very important and we have several mechanisms that we have been looking at.

Senator PRESSLER. Dr. Tilford.

Dr. TILFORD. Within NASA, we believe that if you do not include a very strong university component within any R&D program, you wind up with a very inferior product in the end, as I think we have demonstrated over the past few years and that means for the whole country.

In most of our research and analysis programs, anywhere between 25 and 75 percent of the community we support is in the university community, so we strongly support a very strong university participation within any R&D program. We believe that in this case it is especially true, because it has not been developed in the past few years to the extent that many of the other disciplines have.

As far as a consortium, I guess I would like to hear that debated in some detail because I know of a number of consortiums that have worked very well and I know of others that have not worked very well. But that takes nothing away from our belief that we must have an extremely strong particiation and support of the university research community.

Thank you.

Mr. FREDERICK. Senator Pressler, I share the feelings of my colleagues from NASA and NOAA regarding the value of a strong university connection. It has been a traditional Geological Survey philosophy for a hundred years or so, to make sure that we involve the academic community in our programs and activities.

I think with respect to this question of remote sensing, since the objectives are so diverse and the utilities will be at the local level in the Federal and State Governments and private industry, it is a must to involve the academic community, both in terms of development of the students and the passing on of the capability to those that must use it.

So we support strongly the idea of a strong academic involvement. As far as the consortium is concerned, as Bill Bishop says, we are presently discussing with NOAA the possibility of a research connection with the data archive at Sioux Falls. The possibility of a university consortia would be one of the options I think we would pursue in that connection.

I guess we have not fully debated the issues but will consider that seriously.

Senator PRESSLER. Mr. Watkins.

Mr. WATKINS. I also support and personally believe that there are many aspects of research that can best be carried out by the academic community.

There is another aspect of that because it is the bridge, then, to the classroom; it is the bridge to the people that will be coming out of universities who will be the long-term users of this type of data. So that is a very important aspect.

There are analogies in the consortium world, particularly in the area of atmospheric research. The University Consortium for Atmospheric Research, which uses the National Center for Atmospheric Research as a basic facility, is an example of a consortium that works very well, and there may be something to be learned from looking at that particular analog.

Senator PRESSLER. Yes, Dr. Bishop.

Dr. BISHOP. Senator Pressler, there is one thing that we ought to place on the record, and I neglected that. There is a tried and true method for university involvement that all the agencies use, which is the competitive peer review grant, and I think we all will continue our programs in that area.

Senator PRESSLER. Yes. I know we have a vice president of the University of Iowa here later, and I look forward to visiting with him about this.

Senator Gorton, shall I go on with my questions?

Senator GORTON. Why don't you finish your questions? Yes, go ahead.

Senator PRESSLER. Dr. Bishop and Dr. Frederick, we have discussed in the past the need for a strong Federal archive. I know your two agencies are working together to establish a facility at the EROS Data Center. This has already been touched on briefly, but could you tell me in more detail where you are in the data archive process and what the timetable is for establishing the guidelines and parameters of the archive pursuant to section 601 of the act?

Dr. BISHOP. Maybe I can start that and turn it over to Doyle Frederick in a moment.

We at NOAA felt that until we had EOSAT contracts signed, that we could not correctly proceed with any concrete plans for an archive because we would not know what the data source would be in the distant future.

Once that happened, at about the time we were sure it did happen, we got together with an informal meeting of the two agency heads and reached an agreement in principle on how to proceed, which has three components.

One is to acquire from EOSAT, according to the law as they produce it, a selective data set from whatever data they take. A second component would be an aggressive—shall I call it a buying campaign—to ask EOSAT to acquire specific scenes that would be important to such a data set. And the third component would be to establish at the archive an active use of that archive, which is why we have been talking about a research establishment co-located with the archive.

There is, aside from the bureacuratic steps that we have to take, there is one other step that the law requires. This is for us to put together some kind of an outside advisory panel to give us advice as to what that basic data set should be.

That will be a step we will take as soon as we decide what the composition of such a panel should be.

Perhaps Doyle would respond some on his view of how the Department of the Interior is ready to pick up the ball on this.

Mr. FREDERICK. The agreement, as Bill has suggested, has been reached in principle by the two heads of the organizations, Dallas Peck of USGS and Tony Calio of NOAA. We have agreed to pursue the development of a strategy, and we hope to have it recorded sometime fairly soon. I think, in concept, the question of when we will have completed the organizing principles, established the necessary relationships and that sort of thing, will depend on how quickly we can agree on the fundamental principles, but I do not anticipate, Senator Pressler, that that would be too long; in a matter of 2 or 3 months, I would expect we will have laid out, at least in concept.

There are several questions, that Bill Bishop mentioned, including what type of data one would include, and that will depend in part on the kinds of deals that we can make with EOSAT and with other land remote-sensing satellite operators—SPOT Image, as an example.

The involvement of the private sector, the university community and other agencies also is a critical step that we must take. We are looking at the possibility of establishing some sort of an advisory panel, perhaps through the National Academy, although we need to talk about that a bit further.

We do intend to establish such an advisory committee to give us some advice on both the content of the data base and the operating philosophies, and specifically address questions relating to unlimited access without undue hampering of the commercialization aspect.

Senator PRESSLER. Would you define exactly what is going to be in these archives and how they can be most useful?

And when you say "unlimited access," does that mean for nonprofit uses?

Mr. FREDERICK. Yes, indeed. When I mentioned without hampering the commercialization issue, we surely do not want to establish a facility that would be directly competitive with EOSAT.

Senator PRESSLER. On the other hand, we want to be sure that information is not withheld from scientists and universities that they might have to buy, that should be available to the public; is that not correct?

Mr. FREDERICK. That is true.

Senator PRESSLER. I hope you can find that fine line.

Mr. FREDERICK. That is a good question that we have not finally answered. We have had some preliminary discussions with NOAA and with EOSAT in terms of what might be a reasonable approach to take.

We could, as one alternative, make sure that the data is available, one copy as an example, at the EROS Data Center in Sioux Falls for use of researchers who come to that facility. That is one alternative that is being raised.

Senator PRESSLER. Well, just for the record, what will be in these archives? Let's say for the university consortium and for scientists, what will be in the archives?

Mr. FREDERICK. The LANDSAT information as prescribed in the legislation would be available. The question of what other data to include is still an open one. We have discussed with EOSAT the possibility of making sure that we have systematic coverage of those areas that need to have good coverage, repetitive coverage in areas where repetitive coverage would be specifically useful. Also, in addition to the LANDSAT information, we are talking about other information such as SPOT as a possibility, but we have not answered those questions yet, sir.

Mr. Bishop. Senator Pressler, there is one model that one might use which has not been validated by our two agencies, and that is the model that was developed by the Committee on Operational Remote Sensing, CORSAT, so-called, the "Halbouty Committee", which said that there should be one cloud-free image of all areas of the earth with seasonal coverage in those areas where seasonal coverage made sense, and they went on to define that a little bit. That is a very ambitious data set, and it is one that we would have to look at. That may be what our advisory panel tells us also. That is the only model that I think exists right now.

Senator Pressler. Mr. Frederick, describe to me how you and NOAA plan to deal with the question of widespread research access to the data archive as it pertains to the commercial needs of EOSAT to sell data. What sort of research capability do you see as desirable to have colocated with the archives.

Mr. Frederick. I think we would anticipate a broad spectrum of research applications capability to be colocated with the archive itself. And we think EOSAT would agree that it would be to their best interest to develop the tools needed for specific applications. I think it would create an additional demand and would help in the sale of the operational data, although the question of conflict with the EOSAT objectives would be one that we would have to constantly address. The specific applications would include the applications from the Geological Survey's point of view of earth science information, geology, hydrology, mineral resources, cartography, and the like. We assume that NOAA would be interested in all aspects, including some of those as well as the atmospheric and oceanic kinds of research.

In essence, I think what we would like to do as a minimum is be able to set up a system whereby we have colocated from the USGS point of view many of our own researchers with the archive. In addition, we would like to make sure that the archive is accessible to others in many fields.

Senator Pressler. Will the Federal Government have access to archive data at a cost below the regular commercial price, and if so, how would that cost be determined? I believe the legislation calls for reasonable costs, but that involves some discretion in determining that price. It seems to me that if we are to establish and maintain a strong archive, this is an extremely important issue, and as a corollary to that question, how are we going to make certain that these data will be strictly limited to research purposes?

Mr. Bishop. Perhaps, Senator Pressler, I can answer the first half of that question, and then the rest of the panel could join me in the second half. The first half of the question is costs for the data for the archive. There are three ways that the Federal Government will get data for the archive. One of them is spelled out, in fact, two of them are spelled out in the law. The first of these is, if EOSAT has already acquired a scene, the Federal Government has access to that scene at the cost of reproduction in order to get a copy into the archive.

The second, which is not touched on in the legislation specifically, but is certainly allowed, is for the Federal Government to place a, special order for a scene, a particularly useful scene, for the Federal Government at a normal cost, a normal commercial cost.

The third is, if EOSAT is purging its holdings, the law requires that the Federal Government have access to any data purged from their holdings. And I would assume that that would be at the cost of delivering it to the Government. So, those three mechanisms are available to us. We expect the first of those will be the one largely used, where we will pick something from their holdings that we want in our archives.

As to making it available to researchers, two things to keep in mind. One, EOSAT is going to have to advise us, I believe, also in the Government, on what is competitive with them or what would be competitive with them, and what might cause them problems in their marketing, and we will take their advice on that.

But secondly, there will be the archive itself, and whatever access can be done on site. It is possible that we can make arrangements to even have some offsite use of the data if it is protected from copying and further distribution, and EOSAT will have to advise us on that.

Senator PRESSLER. When you say that EOSAT is going to be competitive, are you talking about with data or user group?

Mr. BISHOP. I meant a distribution of the data outside the EOSAT sales channel, which will be in direct competition with their market for the data. That is something that the law specifically requires that we avoid.

Senator PRESSLER. Mr. Frederick, you mentioned in your statement the possibility of developing the capacity at EROS to receive and process AVHRR data from NOAA's weather satellites. As you may know, there were successful amendments to an appropriations bill last month that would establish this capability at EROS. How would that complement the data already available at the EDC, and is the data from the AVHRR similar to that from LANDSAT?

Mr. FREDERICK. Senator Pressler, we do hope to be able to work out an approach with NOAA whereby the AVHRR data will be available through our Sioux Falls facility for earth sciences applications. We are working with them to do that at the least cost and within existing funds if we possibly can do that. With respect to the question about the relationship with LANDSAT data and what sort of utility we expect from the AVHRR data, we think that is a complementary data set. It is collected much more frequently. It covers a broader area and has different kinds of resolution, and there have developed within the Federal sector and outside the Federal sector some fairly specific uses of that that requires ice monitoring, as an example. Our Water Resources Division uses the information for looking at water use and there are similar applications throughout the earth science community.

I just want to emphasize that we are discussing the feasibility of that with NOAA, and I hope to be able to work out something. We do not consider it to be competitive with the LANDSAT data. We think it is a complementary data set.

Senator PRESSLER. I would address this to the entire panel. Do we make data available for commercial R&D under the same guidelines we established for Federal and academic research, and would we be able to control effectively their use under such circumstances?

Dr. BISHOP. I will take a first shot at answering that question, Senator. There is a fine line that one must draw in dealing with a commercial user of land remote sensing data. Indeed, many of the major companies have research programs which are supported by fairly low cost data, or were, I should say, before the contract was signed on September 22, and many of these are published in the open literature.

On the other hand, there are a number of activities in the same companies which are done for their own proprietary and profit motives, and somehow we need to draw the line. We developed only one thought process on that, and may not be the only one, which would be a simple test that if those companies were willing to submit the proposal for peer review by other companies of a similar nature, that it indeed can't be something of a proprietary nature, because they have opened it to others.

We have not talked about these ideas with EOSAT, and we need to do that to be sure we are not impacting their market, because again the law requires that we not do things with that archive that would impact their market. But I think we can probably come up with ways of doing that.

Dr. TILFORD. We have just gone through the sale of the large format camera data as the first example of selling R&D or experimental data in lot. In that case we have established a policy that any federally supported entity, whether it be in the university, Government, or commercial sector, has to sign a release saying that this data and the results from using this data for R&D will be made available to the public.

That is extremely hard to enforce, as you might perceive. We do not yet know how this can be enforced uniformly across the total applications community. I think it is something we have to work together, with all the agencies involved, and with EOSAT over the next few years. I think it is going to be extremely complicated to enforce on the one hand, but I that we do have to find some mechanisms to do that think in order to make sure that EOSAT can survive.

Mr. FREDERICK. Senator Pressler, we have specifically looked at that idea. I have talked to NOAA just briefly and had some conversation with NASA on the idea. Our basic approach, I think, would be the one that Dr. Bishop suggested, that we ask the commercial user or industrial user to submit the proposal for peer review.

I think we will be asking the advisory panel that was discussed earlier to give us some thoughts in that regard. Beyond that, the U.S. Geological Survey has just recently established a research fellowship program that we intend to implement with the industry whereby we can join with the industry in pursuing research opportunities of common interest, so we might use that approach as a mechanism of peer review in assuring that the activities and research results will be openly available to all.

I think that is the basic criteria—research that would be openly available rather than proprietary—because as I mentioned, we still must consider the charge in the law: That is, to pay attention to the EOSAT concerns and competition with them.

Mr. WATKINS. I think it is vital that we establish the appropriate mechanisms that will allow industry participation in the archive and in the research activity. The mechanics are obviously going to be different than working with either Federal or university or other types of research activities. My own opinion is that where the research is of a general and fundamental nature, that we will be able to establish those mechanics, those appropriate mechanisms, and that they probably will involve the sharing of the results for the research so that everybody has the benefit of that research. Where a particular company has a very specific objective in research that would benefit just that company, that obviously is going to become much more difficult and probably will be handled in a different way.

Senator PRESSLER. Mr. Bishop, you mentioned in your testimony that NOAA is considering establishing a number of cooperative remote sensing institutes at universities. How would this compare to the university consortium idea we discussed, and to what extent would these institutes utilize data from the Federal archive?

Dr. BISHOP. We are considering establishing a small number of cooperative institutes. They differ in only one respect from the institute that might be at the archive, and that respect is that the others would be housed at a university. The cooperative institutes would be housed at a university. The institute at the archive would be housed at a Federal installation.

Only in that respect would they differ. Their functions would be similar. As to how the others have access to the archive data, that is something we have yet to work out. It is obviously something that we need to provide to such cooperative institutes, and we also need to provide it in such a way again that it not adversely impact EOSAT's marketing of the data, that there not be some gray market developed for copies of the data.

Senator PRESSLER. Would you elaborate on the discussions you have had with the French SPOT Image company regarding data for the archive?

Dr. BISHOP. Yes, I can elaborate briefly on that. There were several conditions requested of the French in return for providing to them some NASA developed parts for their spacecraft, and among those conditions was the request that they make SPOT data available to the U.S. National Archive under conditions not unlike those that are imposed on the U.S. commercial operator.

They agreed in principle to that. But we have not yet received their articulation of the details of that agreement. We expect to get that late this week, but we expect at some nominal cost, hopefully the cost only of reproduction, that we can acquire a limited data set, probably a number of limited data set of SPOT data for our archive.

We also expect it to provide them the same sort of protection we provide EOSAT, namely that we not make that data available outside the archive without their express approval somehow.

Senator PRESSLER. I just have one or two questions left, Mr. Chairman. I might say that I had breakfast this morning with Secretary of Interior Hodel, and discussed many of these issues, and he was very responsive and very interested in this hearing today, and I wanted to pass that on because I very much appreciated his comments.

Mr. Frederick, you mentioned in your testimony that plans are being made to place a core group of scientists from NOAA and the Geological Survey at the archive in Sioux Falls, and that you anticipate involving other Federal and non-Government researchers in this as well.

Could you elaborate on these plans and explain the importance of having this type of activity co-located at the Archive? Dr. Bishop, you could comment on that also.

Mr. FREDERICK. Let me start with the latter part of your question, Senator Pressler. The importance, I think, involves two issues. One is, we think that for the health of the archive, it is important to have it used, to be available to the users and have it exercised continually.

As far as the research benefits are concerned, the data obviously has utility. Access to that data for the purpose of supporting research, whether it be an extraction of information from the remote-sensing data or whether it be in combination with a geographic information system for developing analytical tools for decisionmaking we think is there.

As far as the U.S. Geological Survey is concerned, we will locate some of our people at Sioux Falls. We have several there already. We are looking at the possibility of making sure that we are covering most aspects of our research concerns in the earth sciences.

We have other research activities in the Geological Survey, and our researchers would from time to time visit Sioux Falls to conduct certain aspects of their research. As far as NOAA is concerned, I think Bill Bishop will have to comment on their plans.

Dr. BISHOP. Let me react to the importance of colocation of a research establishment at an archive. One assumes that the motivation for having an archive at all is to be able to extract some sort of useful information out of the data that they store there, and the people most likely to successfully extract such information are those who are using it to solve some real problem, be it scientific or applications.

And therefore one is inclined to believe that the best way to manage an archive is to have the management involve those users, that that is what will best make the archive a useful entity. I first heard that sort of advice in a bit of wisdom from the National Academy several years ago in a committee on data management and computation, where they suggested the establishment of a number of data bases around the country wired together, but each one of those data bases to be managed by researchers who had the intrinsic interest in that particular kind of data.

That is why I believe colocation is important. And I am quite willing to work within my own little research establishment to place a small group of NOAA researchers at the archive over time. This is not something that can be done instantly but they would begin making use of that for applications as part of our research program.

Senator PRESSLER. I address this vital question to anyone on the panel, and you may wish to submit written comments later if it is permissible. Is there any need for technical or other adjustments to the legislation? We could just go across the table. Dr. Bishop?

Dr. BISHOP. Okay. I think so. Yes, sir. I have seen, oh, at least several handfuls of suggestions for that, and NOAA is supporting four such suggestions. We received at NOAA an official request from Congressmen Scheuer and Nelson a couple of weeks ago, and, I believe, have sent back our response. At least we have drafted it. And we identified four things that have to do with the contract. One has to do with the length of the Secretary's authority, which is limited to 10 years, which is a little bit less than the extent of the contract. And we have seen several versions of some language that could fix that.

We also think that title to the equipment is something which might be transferred. If the private sector enterprise is successful, they ultimately ought to own the equipment rather than the Government own the equipment. Only through quirks of contract law, well, not quirks, but through provisions of contract law, is the Government is required to own the equipment which we buy through the present EOSAT contract. We think at the end of that contract that it would be wise to allow the Secretary to dispose of that equipment as he sees fit in order to pursue the goal which we had, namely, the establishment of a viable commercial enterprise.

The final thing that we can think of that we thought could be changed in the law that would be useful was that titles II and III require the Secretary to look at the cost versus the benefits, or at least the cost, the cost savings of first the operation of LANDSAT 4 and 5, and secondly, the building of the new system. The law did not provide for the Secretary to look at these in a combined way. We find it very difficult to separate them, and could not intrinsically separate them because they are part of the same stream of activities over the future. In order not to be found some time in the future to be in conflict with the law, that would be a small technical fix.

There are some other suggestions that we have seen from both other agencies and from EOSAT that I think NOAA would be quite supportive of, and let me let the others react to those.

Dr. TILFORD. Yes. There are a number of areas. I brought two of them out, I believe, in my testimony, one having to do with the definition of nondiscriminatory, and the inability of EOSAT and the Federal Government to make any special arrangements outside of the national security area for providing data at a reduced cost to the R&D community.

Number two is sections 502 and 503 which I believe, as written can be extrapolated to include even nonspace data. This makes it very difficult to provide, in a timely fashion, R&D space remotely sensed data to the R&D community, and especially the non-Federally funded R&D community.

Incidentally, we have had a number of discussions over the past 4 weeks, with EOSAT and we fully explained our concerns, and vice-versa, as you will hear later. EOSAT also had some suggestions along these lines, and we are attempting to work these out such that there will be a common understanding between NASA and EOSAT.

I think a third and a minor technical difficultyas now stated in the law, is that it is impossible, even for an R&D researcher, to publish an enhanced image in the open literature without written approval from EOSAT. We think this is something that probably could be fixed very easily.

Thank you.

Mr. FREDERICK. I have one area to mention, and it would be in support of Dr. Tilford's suggestion that perhaps some clarification of the availability of experimental data to the data distribution system in the archive would be helpful.

Mr. WATKINS. Just to echo that point, it is critical that experimental data be handled in such a fashion that it is easily available for the purpose for which it was acquired, which is experimental and research purposes and at the same time, not in any way be allowed to compete with the owner-operator in his market development.

So that is a tough fence to walk, and we will have to turn our attention to how the legislation can be modified to accomplish that end.

Senator PRESSLER. Thank you.

Mr. Chairman, I think this panel has done an excellent job of laying a legislative history or a basis for future reference, and I want to compliment them.

Senator GORTON. Thank you, Senator Pressler.

Dr. Bishop, when we were interrupted by the roll call, I was asking you about the joint national plan. I have one more question on that subject, and I will ask the reporter to include your answer to this question at the end of your answers to my earlier questions.

One thing about producing a NOAA plan is that NOAA and NASA make no assumptions about the availability of funds, and I regret to say that that might be an appropriate nonassumption. Is it your belief that the Congress should turn elsewhere for suggestions about the appropriate role of the Federal Government and remote sensing research?

Dr. BISHOP. Mr. Chairman, I think the Congress should listen to what we bureaucrats and the administration have to say about the appropriate role of the Government, but I found in my own conversations about that over the last few years that I have gotten a lot of insight by talking to a number of private sector firms about the appropriateness of roles.

I claim no expertise in the marketplace except what little bit I have learned in studying one particular commercialization this last year, but I found in several fora where I sat with executives from large and small companies that I learned a great deal about both their aspirations and their concerns, and so I would highly commend to you panels of private sector people to talk about appropriate roles of the Federal Government.

Senator GORTON. Thank you.

Dr. Tilford, both in your testimony and in your response to a number of questions by Senator Pressler, you referred to NASA's difficulty in cooperating with researchers on the provisions of section 502. Would NASA like to make available data which are not similar to privately generated data, and thus would not compete with private systems?

Dr. TILFORD. I think I certainly agree with everything that Al Watkins said. I think it is extremely important that with R&D data we make it available to as large a community as possible as soon as possible.

Senator GORTON. That is the purpose of it, isn't it?

Dr. TILFORD. That is correct, and I think as the law is now written it stymies that to a certain degree because we do have to go through the procurement process in making this data available, en bloc to whoever might want to bid on it. This is a timely procurement process, so it does delay making the data available as soon as possible to as large a community as possible. Ultimately we hope these R&D products will lead to an improved marketplace for the commercial operators of any of this data which might be commercialized or privatized in the future.

We fully concur with the objectives of the act. The implementation is somewhat difficult to deal with.

Senator GORTON. section 502 states that agencies may disseminate data for cooperative research programs provided that such programs are not commercial, and do not compete with private sector activities. Does NASA interpret this language to mean that data may be provided only to Federally funded researchers?

Dr. TILFORD. We have made that interpretation based upon the fact that we would not have any control if we made the data available to anyone who wanted it. Furthermore, I believe, as that legislation reads, it does not refer simply to space obtained data, but if that space obtained data might be in competition with any other kinds of data, it also prevents us disseminating on a broad basis.

Senator GORTON. Will NASA submit to this Committee specific statutory language loosening the restrictions on dissemination of experimental data in a way that will not undermine private marketing efforts?

Dr. TILFORD. We will submit such suggestions for modifications.

[The following information was subsequently received for the record:]

Proposed NASA amendments to P.L. 98-365:

section 104(3)(A) should be amended by inserting in the third line after "section 607" the following phrase: "or federally funded research and development activities."

section 502 should be amended by changing the "or" in the next to last sentence to "and."

Senator GORTON. Looking at this perhaps from an opposite point of view, with the encouragement to engage in cooperative research, to what extent can NASA cooperate with private industry without actually designing system components to the specifications of particular private entities?

Dr. TILFORD. That is a very good question. EOSAT and NASA have had a number of discussions over the past few months in terms of what EOSAT would like NASA to do. We believe that, again under the current terms of the act, it is going to be very difficult. I think you brought out a very important point, though. Are we dealing with EOSAT, a specific entity here, or should we be dealing with the commercial sector in a generic form in terms of providing specific instrumentation to EOSAT on the one hand or providing capability that any industry might take advantage of in the future if they might want to compete with EOSAT?

I think these are issues that we have to discuss in depth. We have asked both the NASA Advisory Committee and the Space Application Board to review this issue and make recommendations both to us and hopefully to you, in terms of what is an appropriate forum and mechanism for NASA, NOAA, and the other agencies to work with EOSAT in that particular realm, and how do we go about implementing such?

Senator GORTON. Mr. Frederick, with any comments Mr. Watkins wishes to make, Mr. Frederick, you mentioned in your statement that providing research into the widespread access into the Federal archive might actually stimulate EOSAT's market. Could you elaborate on that, in what fashion?

Mr. FREDERICK. Senator Gorton, we think that the market has not been fully developed yet from that point of view. We mean that all of the utility at the local level has not quite been demonstrated.

The researchers who we are talking about will be involved in the development of analytical tools that can be used by land planners, by agricultural experts, by State and local Government officials, and by industry in their day-to-day decisionmaking for the management of lands and other resources. And we think by the use of the basic information out of the archives and the development of those analytical tools, that technology can be transferred to a broader base, and subsequently developing a demand for the data that can be used to solve problems on a day-to-day basis.

Senator GORTON. I want to thank the four of you for your long, interesting, and exhaustive testimony. There may be a few more questions submitted to you by this side or by Senator Pressler. We do have some written questions from members of the minority which we will submit to you for which we solicit your answers.

With that, we wish to thank you very much.

We will now hear from Mr. Charles Williams.

STATEMENT OF CHARLES P. WILLIAMS, PRESIDENT, EARTH OBSERVATION SATELLITE COMPANY

Mr. WILLIAMS. Thank you, Mr. Chairman, and good morning. I am pleased to be here today, and I have a short statement to read, and then I will be available for questions.

In response to the Subcommittee's request, first let me summarize very briefly the current startup status, if you will, since September 27 of the land remote sensing commercialization effort.

EOSAT has initiated in concert with its contract agreement a matrix organizational structure to both manage and administer the overall program. We have filled most of the designated key personnel positions, and have implemented an overall marketing strategy to establish both EOSAT and LANDSAT credibility in the overall marketplace while addressing several specific international targets of opportunity.

We have taken over management of the LANDSAT system at the Goddard Space Flight Center and in conjunction with the EROS Data Center, as previously mentioned, at Sioux Falls, have initiated a joint industry and Government order inventory and data distribution plan.

It is worthy to note at this point that the overall transition from the Government to the private sector even in this very short stage of activity is proceeding very smoothly, and that is only with the help of the NOAA and EROS personnel, and we are quite happy to have them as part of our overall team for Government and industry.

In accordance with our contractual agreement with the Department of Commerce, we have publicly advertised our basic price list, and have disseminated it on a worldwide basis. In order to better educate the overall user community, we have participated in many presentations, briefings, and workshops which have been conducted both here and in Europe to educate the community on a face to face basis relative to product pricing, data ordering, dissemination, and also the understanding and intent of Public Law 98-365.

We as EOSAT have issued letter subcontracts to RCA, Santa Barbara Research Center, Computer Science Corporation, and Earth Satellite Corporation, the major subcontractors for spacecraft and sensor development, also, the initiation of the conceptual design of the new communications and image processing ground system, and for applications and marketing support.

We have a new headquarters for international activity including marketing which is being completed in the Lanham, MD, area, and will be ready for occupancy in December. We feel that the program implementation status at this point in time is very positive, and we are very confident in our ability to continue this thrust.

With respect to the legislation itself, we at EOSAT feel that the legislation passed in July of 1984 established a true key milestone in space commercialization, particularly for the application of remote sensing. The legislation, along with the subsequent budget approval in August of 1985 helped to take remote sensing out of its long-term transition stage, and allow an emphasis to be placed on industry applications, requirements, and constraints along with the Government's obligations for oversight and continued research and development.

Due to the very high cost of development of advanced sensors and payloads needed for the outyears, Government participation and involvement is mandatory if the United States is to retain any form of technological advance or leadership over the heavily subsidized French and Japanese systems.

As an aside, one of the techniques emphasized by EOSAT in our overall marketing strategy is the Center of Excellence program where remote sensing research in applications, processing techniques, and sensor developments is sponsored through Government science grants, EOSAT data grants, and with EOSAT technical support.

We feel that this technique is an economical and effective way to continue some forms of research, and have Government, industry, and the academic communities involved.

The remote sensing legislation, while far-reaching, does have some inconsistencies which are of concern to EOSAT as a private operator.

One specifically, section 202(a)(4), prohibits the contractor from making data grants to researchers such as those involved in the Center for Excellence program. The legislative history suggests that the legislators' intent was to prohibit the contractor from having access to free data if it became a value added processor.

The intent is clear, but we feel the language is overreaching. We would propose that language be added to the existing section allowing scientific data grants on a technically competitive basis to academic institutions and other research organizations conducting programs of research and/or development in remote sensing.

A very explicit example is in research on cloud cover, where data is used which for the most part is not viable or saleable commercially. It could be used by research institutions doing cloud cover or snow cover research.

Section 306 of the act provides that 2 years after the commencement of title III, the Secretary shall report to the President and the Congress on the progress of the transition to fully private financing, ownership, and operation of the private remote sensing systems.

It seems appropriate to us in the private sector that either in this section or in the section on research and development that additional language be added requiring a contractor, the system operator in this case, to provide a report from its perspective regarding research and development of remote sensing technology and on related topics.

Our proposed language for section 306 (b): "Two years and every year thereafter after the date of the commencement of the 6-year period described in section 304(a)(2), the contractor shall report to the President and to the Congress on the progress of remote sensing research and develpoment and on the transition to fully private financing, ownership, and operation of private remote-sensing space systems, together with any recommendations for actions necesssary to ensure U.S. leadership in civilian land remote seensing from space."

EOSAT has a few other recommendations for clarification to the current "act" which we feel would improve the language and centralize the focus and intent for both Government and industry.

Thank you for your attention. I would be happy to respond to any questions.

Senator GORTON. I would like you to tell me whether or not EOSAT will wait for the failure of LANDSAT 5 before launching LANDSAT 6.

Mr. WILLIAMS. As the question is phrased, I do not believe it agrees with our overall plan. Our basic program plan in concert with NOAA indicates that the end of the design life of LANDSAT 5 is March 1987. The planned launch of LANDSAT 6 is December 1988. Based upon the long-term hiatus between the design life of 5 and the launch of LANDSAT 6 we would prefer that LANDSAT 5 fly as long as is practically feasible.

There is a point in time when the practical demise of LANDSAT 5 may have to be declared in order to transition the equipment to launch of LANDSAT 6. So to that extent we as part of our program plan would prefer that LANDSAT 5 fly as long as June 1988, if that is possible.

Senator GORTON. I would like you to answer some questions on pricing policy. In setting your prices for data products, what market segments have you focused on, and what has been the reaction of the user community? How will EOSAT's prices compare with those of products in foreign systems?

Mr. WILLIAMS. I think in response to the first question, that EOSAT has provided a marketing and pricing plan which deals with the market in general. The way our marketing and pricing plan is constructed during the early years, we deal basically with the nonrenewable resource industry such as oil and gas, and in the later years more emphasis is placed upon the renewable industries such as food production or agriculture. But basically we deal with the overall market in the area of nonrenewable and renewable resources both.

As far as the reaction to the user community, I think that generally the reaction has been extremely good. There have been a few minor comments from specific areas which are influenced by policy where data was disseminated on a free basis before, if you will, but by the same token, the general reaction of the international community both through survey and through direct interface with major organizations is favorable.

I think the last part of that question was, how will the prices compare to the prices of the foreign data system? I think in that case I can only provide, as you indicated, a comment. First of all, we do not have any structure or estimated pricing from the Japanese system or the potential of the European system.

The SPOT prices have been announced verbally, and a basic comparison of those shows that SPOT has been reducing or revising their pricing structure to agree with the EOSAT pricing structure. As our prices were advertised, they were slightly less in a number of cases, key cases, less than the NOAA advertised price list.

Senator GORTON. Is EOSAT concerned that foreign ground station operators will disseminate data under different conditions than EOSAT must under the act, and do you have any suggestions, if you do have such a concern, as to how to resolve it?

Mr. WILLIAMS. The answer is yes. There is one basic inconsistency, we feel, in the law that requires a minor clarification that will allow us to participate on a more active basis with the ground stations and have a more competitive pricing structure, if you will, with the areas that they are involved in.

We would like to submit, if you will, for the subcommittee review a list of those minor clarifications under separate cover.

Senator GORTON. We would like to get that from you. Does EOSAT believe that data disseminated from the Federal Archive will reduce EOSAT's marketing opportunities? What terms of data availbility from the archive does EOSAT believe would be appropriate?

Mr. WILLIAMS. I am afraid there again I would have to refrain from comment, because we have not reviewed the Federal archiving plan to this date, and I personally have not seen the overall orientation of the plan.

Senator GORTON. That is something we would like you to comment on in writing.

Mr. WILLIAMS. We would be happy to do that in writing after a review of the plan.

Senator GORTON. Thank you. Will you provide for our hearing record a summary of EOSAT's comments on the specific provisions of the act along with an analysis of the effect of given provisions and any changes in addition to those in your formal written statement which you are recommending?

Mr. WILLIAMS. Yes, we would be happy to do that in a written statement under separate cover.

Senator GORTON. Fine. Other members of the Committee, I think, will probably have additional questions in writing for you, Dr. Williams, but we thank you for your cooperation and your testimony.

Mr. WILLIAMS. Thank you, Dr. Chairman.

[The statement follows:]

STATEMENT OF C.P. WILLIAMS, PRESIDENT, EARTH OBSERVATION SATELLITE CO.

Thank you Mr. Chairman, I am happy to be here today to testify on behalf of the Earth Observation Satellite Company (Eosat). In response to the subcommittee's request, first let me summarize Eosat's current status relative to the land remote sensing commercialization contract which was awarded on 27 September of this year.

We have initiated a matrix organizational structure to manage and administer the overall program. Eosat has filled most of the designated key personnel positions and implemented an overall marketing strategy to establish Eosat/Landsat credibility in the marketplace, while addressing several specific international targets of opportunity. We have taken over management of the Landsat system at Goddard Space Flight Center; and in conjunction with the Eros Data Center at Sioux Falls, South Dakota have initiated a joint industry—government order/inventory/data distribution plan. It is worthy noting that the overall transition from the government to the private sector is proceeding very smoothly with the help of NOAA and Eros personnel.

In accordance with our contractual agreement with the Department of Commerce, we have publically advertised our basic price list, and disseminated it on a worldwide basis. Presentations, briefings and workshops have been conducted both here and in Europe to educate the data user community on a face-to-face basis relative to product pricing, data ordering and dissemination.

Eosat has issued letter subcontracts to RCA, Santa Barbara Research Center, Computer Science Corporation, and Earthsat for spacecraft and sensor development, conceptual design of a new communications and image processing ground system, and applications and marketing support. Our new international headquarters and marketing facility is being completed in Lanham, Maryland, and will be available for occupancy in December. We feel that our implementation status at this point in time is very positive, and we are confident in our ability to continue this trust.

We at Eosat feel that the legislation passed in July 1984 established a key milestone in space commercialization, particularly for the application of remote sensing. The legislation along with the subsequent budget approval in August 1985 helped take remote sensing out its long-term "transition" stage; and emphasized industry obligations, requirements and constraints, along with the government's obligations for oversight and continuation of advanced research and development. Due to the very high cost of development of advanced sensors and payloads needed for the out-years, government participation and involvement is mandatory if the United States is to retain any form of technological advance or leadership over the heavily subsidized French and Japanese systems.

One of the techniques emphasized by Eosat in our overall marketing strategy is the center of excellence program; where remote sensing research in applications, processing techniques and sensor developments is sponsored through government science grants, Eosat data grants and Eosat technical support. We feel that this technique is an economical and effective way to continue some forms of research and have government, industry and the academic communities involved.

The remote sensing legislation while far-reaching does have some inconsistencies which are of concern to Eosat as a private operator. Section 202(a)(4) prohibits the contractor from making data grants to researchers (such as those involved in the center of excellence program). The legislative history suggests that the drafter's intent was to prohibit the contractor from having access to "free" data if it became a value added processor. The intent is clear, but the language overreaching. We would propose that language be added to the existing section allowing scientific data grants on a technically competitive basis to academic institutions, or other research organizations conducting programs of research and/or development in remote sensing.

Section 306 of the "act" provides that two years after the commencement of title III the Secretary shall report to the President and the Congress on the progress of the transition to fully private financing, ownership and operation of remote sensing systems. It seems appropriate (either in this section or in the section regarding research and development) that a new section be added requiring the contractor to provide a report from its perspective regarding research and development of remote sensing technology and related topics.

Our proposed language for section 306(b): "Two years and every year thereafter after the date of the commencement of the six-year period described in section 304 4(a)(2), the contractor shall report to the President and to the Congress on the progress of remote sensing research and development and on the transition to fully private financing, ownership, and operation of private remote-sensing space systems, together with any recommendations for actions necessary to ensure United States leadership in civilian land remote sensing from space." Eosat has a few other recommendations for clarification to the current "act" which we feel would improve the language and centralize the focus and intent for both government and industry. We will submit these under separate cover to the subcommittee.

Thank you for your attention. I would be happy to respond to any questions.

QUESTIONS OF SENATOR GORTON AND THE ANSWERS

Question. Will EOSAT wait for the failure of Landsat-5 before launching Landsat-6?

Answer. As part of the contract with the Department of Congress, EOSAT is responsible for the design, construction, and launching of Landsats 6 and 7. The design process began shortly after release of the contract on September 27, 1985. Construction and integration will be completed in time for a December 1988 launch at the earliest. EOSAT is hopeful that Landsat-5 will surpass its 3 year design life, currently projected through February 1987. If there is a premature failure of Landsat-5 it is not technically possible to launch Landsat-6 sooner than our projected date.

However, EOSAT and all users of Landsat data will benefit if Landsat-5 survives longer than was initially planned. Currently there is a gap between the predicted useful lifetime of Landsat-5 and the launch of Landsat-6. Anything that could close that gap would benefit all users of Landsat data. However, at some point there will need to be a transition period for the transfer of ground equipment dedicated to Landsat-5 to Landsat-6 and in that regard Landsat-5 may need to be declared inoperative before the end of its useful life. The EOSAT/DOC contract states that the practical demise of the space and ground segments of the Landsat-5 system shall be determined by the Secretary of Commerce or his designee after consulting with the Contractor. Because of the equipment which must be rededicated to Landsat-6 the practical demise must be declared before launch of Landsat-6 can occur. Therefore, it is clear that the Secretary of Commerce and EOSAT must approach this decision together.

Question. In setting prices for data products, what market segments has EOSAT focused on?

Answer. The focus of EOSAT's marketing plan is basically on the non-renewable resource industry such as oil and gas and the renewable industries such as agriculture and forestry.

Question. What has been the reaction of the user community to EOSAT's price structure?

Answer. There has been a few minor comments from specific areas which had arranged for low cost or free data in the past. The general reaction, both in the United States and internationally has been favorable especially in that the basic price of the Computer Compatible Tape (CCT) was lowered immediately upon award of the EOSAT contract.

Question. How will EOSAT's prices compare to the prices of data products from foreign systems?

Answer. Neither the Japanese nor the French have announced firm prices for their products or services. EOSAT's prices will have to be competitive in order to achieve the planned market share forecast for the next ten years.

Question. What is your impression of the SPOT system's preliminary marketing efforts and what are the implications for EOSAT's market prospects?

Answer. SPOT's marketing efforts appear to be extremely well funded, intensive and manned by very qualified personnel. Their primary focus is on the existing users of the U.S. LANDSAT system. When one considers that SPOT wil be launching improved sensors every two to three years, EOSAT expects SPOT to be formidable competition.

Question. Is EOSAT concerned that foreign ground station operators will disseminate data under different conditions than EOSAT must under the Act, and what can be done to resolve such a situation?

Answer. EOSAT is concerned but the record to date of the foreign ground station operator's compliance to the federal government policy of non-discriminating access has been excellent. EOSAT is prepared to do what is necessary to continue to protect this policy in any future memorandum of understanding.

Every indication to date is that the foreign ground station operators recognize that they must support the commercial plans and policies of EOSAT in order to assure the continuity of data under the most favorable economic conditions for themselves.

Question. Does EOSAT believe that data disseminated from the federal archive will reduce EOSAT's marketing opportunities and what terms of data availability from the archive does EOSAT believe would be appropriate?

Answer. The Federal government should not be distributing any data from EROS at this time unless EOSAT specifically released it for distribution. The Landsat commercialization contract transferred exclusive marketing rights to the data to EOSAT for ten years or until EOSAT releases the data.

At some point there might be data released by EOSAT that could eventually be sold or used in competition with data that was recently sensed and in EOSAT's inventory, but that is unlikely. It is also probable that EOSAT will release some of the older MSS material because its marketing activities will concentrate on TM data. Generally speaking, however, terms of data availability will depend on whether the data is being sought for research or commercial use.

Question 6. Does the Act inhibit EOSAT's ability to provide data grants to researchers?

Answer. Section 202(a)(4) prohibits the contractor from making data grants to researchers. The legislative history suggests that the drafter's intent was to prohibit the contractor from having access to "free" data, and thereby an unfair economic advantage, if it became a value added processor.

EOSAT would propose the following language: 202(a)(4) "shall provide that the contractor pay to the United States Government the full purchase price of any unenhanced data that the contractor elects to utilize for purposes other than for sale. Data grants on a technically competitive basis to colleges, universities, or other research organizations conducting programs of research and development in the applications of remote sensing, providing that results of such programs enter the public domain, shall be exempt from this provision".

Question 7. Will you provide for our hearing record a summary of EOSAT's comments pertaining to specific provisions of the Act along with an analysis of the effect of given provisions and any changes which EOSAT recommends?

See Attachment A.[1]

QUESTIONS OF SENATOR PRESSLER AND THE ANSWERS

Question. 1. I know that EOSAT is supportive of a strong ongoing Landsat R&D program. Could you comment briefly on how this could affect your market potential and Landsat operations?

Answer. Both sensor and application research and development must continue and expand. Research leading to the next generation of sensors needs to continue if the U.S. is to remain in the forefront of remote technology sensing which is one of the fundamental purposes of the Act. From a practical standpoint, EOSAT's market will be affected if other countries or entities are using the next generation of satellites and offering a superior product. Landsat operations (and a strong United States leadership role in land remote sensing as required in 102(2) of the Act) will benefit from new sensor technology, but only if changes in the processing technology and data application advances come as well.

Application research and development is crucial to the viability of the commercialization of land-remote sensing, and EOSAT looks forward to working with university, government and private researchers in this regard. Regardless of what happens to the development of new sensors, work must continue if we are all to understand the potential applications of Landsat data. Furthermore, the market will have to be stimulated and new ways found to use the data acquired by Landsat if commercialization is to be successful. This obviously will have the most direct impact on market potential—if more applications are found then more customers will purchase data.

Question 2. Do you think we can develop adequate guidelines to ensure that data made available for research can be restricted so as not to interfere with commercial sales?

Answer. Yes, guidelines can be developed, but the guidelines themselves will depend on the entity disseminating the data. EOSAT supports a strong research program for the reasons set forth in the response to Senator Pressler's first question. EOSAT is concerned, however, that the guidelines result both in the successful commercialization of the Landsat system and in a comprehensive research program.

Question 3. Do you support the university consortium idea? What other R&D activities are you involved with?

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[1] Attachment A was retained in the Committee files.

Answer. EOSAT supports the University consortium idea in addition to other techniques—all of which will provide a broadbased applications R&D activity for remote sensing. NOAA, NASA, the Universities and other agencies are expected to participate in applications R&D.

Question 4. Would EOSAT be willing to provide data to the government archive at cost if you were convinced that it would be strictly limited for research purposes?

Answer. EOSAT is, pursuant to its contract dated September 27, 1985, providing data to the archive for the cost of reproduction and transmission. This should be differentiated from data which EOSAT has agreed may be released for research purposes. It is not EOSAT's intent, nor we believe the Congresses' intent, to have all data in the archive available for research. EOSAT believes guidelines can be developed regarding the release of data from the archive for research purposes.

Question. Could you describe how you plan to continue to make use of EROS in the future?

Answer. EROS will be NOAA's archive repository and EOSAT expects to be supportive of that objective. Also, if EROS is to become a remote sensing applications R&D center, EOSAT would expect to participate in the planning and implementation toward the successful commercialization of remote sensing.

Question. Do you think any adjustments are needed in the legisation?

Answer. See Attachment A.

QEUSTIONS OF THE MINORITY AND THE ANSWERS

Question. Could you please inform the Committee what particular remote sensing research and development activities are planned by EOSAT? Is it true that EOSAT will include a thermal infrared sensor in Landsat 6 and 7?

Answer. R&D activities planned by EOSAT are focused on applications which would increase the usefulness to the community of remote sensing and thereby increase sales and foster commercialization. In mid 1986 we will decide whether to include TIR bands in Landsat 7. At the present time, there is a cooperative program underway between industry, various government agencies and several universities to define the bands for such a system improvement.

Question. Will EOSAT be required to support an ongoing R&D program to remain competitive with other commercial remote sensing entities.

Answer. Yes. Both the Japanese and French governments are supporting the development of advanced sensors which will result in an overwhelming competitive advantage.

Question. Has EOSAT ever approached NASA with a remote sensing R&D shopping list that would improve their competitive posture?

Answer. Yes. There is a continuing dialog with NASA with regard to instrument modifications such as TIR and new instruments such as a MLA. There is no plan nor any budget at the moment. Also, EOSAT would anticipate approaching NASA with a "shopping list" for applications R&D.

Question. Does EOSAT plan any "application" research?

Answer. Yes. EOSAT plans to do application R&D in-house, to sponsor others and to encourage the proliferation of centers of excelence or university consortia in the furtherance of remote sensing. Permission to make data grants toward this end will be critical. It is expected that the payoff from this effort will be 4 to 5 years or shorter as opposed to NASA emphasis on long term scientific break throughs.

Question. Does EOSAT plan to develop two different satellites—Landsat 6 and 7? Or will you merely exchange the key elements of Landsat 6 to obtain Landsat 7?

Answer. EOSAT recently proposed to the Department of Commerce the concept of a serviceable polar orbiting platform that could be upgraded on-orbit. If this proposal is accepted EOSAT would indeed be able to upgrade the satellite by exchanging modular components on-orbit. Should this concept be rejected, EOSAT is prepared to construct, integrate, and launch two satellites.

Question. In this day and age of satellite repair and retrieval capabilities, are "modular" commercial satellites the key to commercial endeavors in sectors with quickly evolving technologies?

Answer. Although yet to be fully tested in a commercial environment, mantended platforms certainly are an attractive alternative to one-use satellites. Currently, heavy investments are required in satellite hardware. If these costs could be reduced through use of a single repairable and retrievable satellite, it would be possible to fly multiple discipline-oriented sensors on a single spacecraft, rather than a single spacecraft/sensor combination for each mission. This is a commercially attractive option. Historically, the Skylab program provided the prototype for such a concept. In Skylab, NASA was able to conduct multiple experiments from a single satellite at a great savings to the taxpayer.

Question. Could you please give the Committee an update on your contractual agreements with the foreign ground stations? Are these nations willing to pay for the receiving station adaptations required to use the new bands? What is the current annual charge to a foreign ground station? What will the annual charge be under the EOSAT contract?

Answer. Pursuant to Section 205 of the Act, EOSAT is currently acting as an agent of the United States government regarding the current Memoranda of Understanding ("MOU"). EOSAT is preparing to begin negotiations with foreign ground station operators regarding renewal of those MOUs which expire in 1987.

The foreign ground station operators seem to be willing to make those adaptations necessary to receive Landsat 6 and 7 data. The exact changes and costs necessary to adapt each ground station must be developed in the near future.

Currently, through the useful life of Landsat 5, a ground station pays $150,000, per quarter, plus a small royalty for data sold. EOSAT has not yet established the prices for future MOUs associated with Landsat 6 and 7.

Question. Does EOSAT, or either of the parent companies, plan to establish a value-added services company? Isn't EOSAT a participant in the Mississippi Commercial Center of Excellence which will address remote sensing "applications" R&D which is critical to the value-added industry?

Answer. EOSAT does not at this time plan to establish a value-added service company. Nothing in the Public Law prevents EOSAT from entering the value-added business. However, EOSAT believes that its plan of encouraging the development of a remote sensing value-added service industry is more practical at this time. However, at such time as EOSAT believes that it must stimulate the market-place by providing new types of value-added services in order to insure the success of the unenhanced data market, it will explore developing a value-added services company.

EOSAT is a participant in the Mississippi Commercial Center of Excellence. EOSAT hopes that the Center of Excellence concept will be one mechanism that EOSAT can use to help encourage the development of the value-added service industry infrastructure that is critical to the long-term success of EOSAT's commercial venture.

Question. For the record, would you please supply the Committee with the proposed EOSAT "pricing regime" per scene and the associated acquisition charges. How do they compare to the current data charges?

Answer. A current EOSAT price list is attached as Exhibit B. Generally, EOSAT has moved to reduce the cost of digital data and associated services. Image products have increased slightly to account for the larger costs associated with production of these items.

Question. Does EOSAT perceive the demand for remote sensing data as elastic or inelastic to price?

Answer. Data sales records from EDC since NOAA assumed control of the Landsat program would suggest that demand has reduced temporarily each time that the price has been increased while the dollar volume has held steady. This probably is a reflection of lengthy budget cycles of customers rather than demand elasticity to price.

Question. What will be the effect of the price increases on the total numbers of scenes acquired annually by the Federal government? The total cost to the Federal government?

Answer. Since, in fact, the bulk of the Federal data sales are in digital data and these prices have decreased, the impact of commercialization on the government should be positive. Federal agencies should be able to acquire more digital data for the same limited budget dollar.

Question. What will be the effect of these price increases on the R&D community?

Answer. If the R&D community has been paying the full price to NOAA, they now would pay approximately 25% less. EOSAT is suggesting revisions to the law which would permit the use of data grants to support those R&D efforts which will have a possible near term (3 to 5 years) payback to the objective of commercialization of remote sensing.

Question. Section H-35 of the Contractual Agreement precludes the piecemeal sale of experimental data by the government in competition with the marketing efforts of the contractor. Does this section preclude such a sale if it is not in competition with EOSAT's marketing efforts?

Answer. Two distinct documents must be reviewed to answer this question: the Land Remote Sensing Act of 1984 (hereinafter the "Act") and the contract. The Act prohibits the government from selling data, except as described below. Section 502 of the Act specifically states that data gathered in federal experimental remote sensing space programs may be used in related R&D programs funded by the federal government but not for commerical uses *or* in competition with private sector activities except pursuant to Section 503. 503 says that *if* the federal government sells the data it must do so *en bloc* through a competitive process. Data is not to be sold on a piecemeal basis.

Furthermore, the Landsat commercialization contract restricts *all sales* by the government of such data to ane bloc sales. Distribution by means other than sale (*i.e.* data grants for research purposes) are not covered by the contract. If the experimental data is sold piecemeal by the Government in competition with the marketing efforts of the contractor, then the Law and the Contract will have been contravened.

Question. It has been stated in some quarters that OMB's brokerage of the contract and cap of the transitional subsidy forced EOSAT to make better business decisions.

Would you agree with this statement? Is it fair to assume that better business decisions also make EOSAT more competitive?

Answer. OMB's budgetary cap provided EOSAT, the Department of Commerce and the Congress an opportunity to excel. The risk to successful commericalization was increased significantly by the reduction in the initial use of capital planned for sensor development which would have allowed EOSAT to competer withthe French and Japanese governmens supported remote sensing industry in the early 1990s. The present contract assures the continuity of the existing Landsat capability unitl the mid 1990s. EOSAT, DOC, OMB and the Congress must continue to work together on future business decisions that will make EOSAT more competitive and which will result in continued U.S. leadership in remote sensing.

Question. Who will be the principal firms in competition with EOSAT? Is the Federal government a competitor?

Answer. The heavily subsidized French firm, SPOT will be the principal competitor. However, Canada, Japan, and the European Space Agency will all have satellites capable of competing with EOSAT. Since all these efforts are heavily subsidized by their respective governments, EOSAT will be at a disadvantage.

The Federal government is not a competitor with EOSAT if the Federal government follows the mandates of the Act.

Question. For the record, would you please supply the Committee with any technical changes to the Act (P.L. 98-365) that EOSAT feels are necessary and would enhance EOSAT's ability to carry out the intent of the Act?

Answer. See Attachment A.

Question. The fact that the government retains title to Landsat 6 and 7 in your contractual agreement is a most unusual provision.

Answer. Would you please expalin the origin of this provision? In light of this provision, can one truly describe this contract as providing for the privatization of Landsat?

How does this provision affect the cost to EOSAT for government provided services, e.g. if NASA were to provide tracking and telemetry to EOSAT, would EOSAT pay the "commercial" rate or government rate for these services?

The origin of the title to the Landsat 6 and 7 system remaining with the government is a direct result of the tax laws. A direct contribution by the government would be considered income for income tax purposes and, after taxes were paid, result in only half the contribution amount being used for commericialization. The limit of the financial contribution of the government to Landsat commercialization to $250,000,000 made it imperative that every dollar be used as effectively as possible. The provision is one that is really menat to enhance the use of the subsidy to ensure successful commercialization. This contract provision has no effect on the cost EOSAT will pay the commercial rate but will, of course, negotiate for the best available rate.

Senator GORTON. Dr. Henderson, Dr. Arvidson, Dr. Spriestersbach, Dr. Holter, and Dr. Murphree.

Dr. Henderson, we are going to let you start. As you see, we are beginning to run out of time, so we are going to have to enforce that 5-minute rule. All of your written statements will be included in the record. So we would most appreciate it.

Senator PRESSLER. Dr. Chairman, I committed the faux pas of out doing a TV interview during the last witness. I will submit questions to him for the record, or if there is time at the end, I will have him back, so if he could stay.

Senator GORTON. We have reserved that.

Dr. Henderson.

STATEMENTS OF DR. FREDERICK B. HENDERSON, III, PRESIDENT, GEOSAT COMMITTEE; DR. RAYMOND ARVIDSON, ASSOCIATE PROFESSOR OF EARTH AND PLANETARY SCIENCES; DR. DUANE C. SPRIESTERSBACH, DEAN OF GRADUATE PROGRAMS, UNIVERSITY OF IOWA; MARVIN HOLTER, ENVIRONMENTAL RESEARCH INSTITUTE OF MICHIGAN; AND DAVID MURPHREE, INSTITUTE FOR TECHNOLOGY DEVELOPMENT

Dr. HENDERSON. Thank you, Dr. Chairman.

Since I am at the end of the table, I will speak first, I guess. In any case, I appreciate the opportunity to speak here on behalf of the GEOSAT Committee regarding early implementation of the LANDSAT Act.

Most of the members of the GEOSAT Committee believe the LANDSAT law is a good law and should not be prematurely amended at this time. However, we have several concerns. I have several documents I would like to submit to the record.

Senator GORTON. They will be included by reference.

Dr. HENDERSON. I shall go over some of my notes here quickly. Specifically, we are interested in the development of the unified national plan as called for by the act. We have had the privilege of reviewing the documents, and we realize the efforts that have gone into that document, but specifically we have some particular points we would like to have you keep in mind subject to review.

We realize that there are a number of reports that are very pertinent to that document which are forthcoming and will be available the first of the year. We also hope that the results of the research objectives stated at the Fifth Flagstaff Workshop completed last week will be included or considered for inclusion.

Also, a number of our ideas are be included in the keynote address given by John McElroy at that meeting which I have isubmitted for consideration.

Specifically regarding such a national plan, we believe that the following points must be kept in mind. Very importantly, for such a national plan to be meaningful, it must have the support of the executive branch in the budget review process.

Secondly, a clear definition of the roles that Government, private sector, and academia as they relate to remote sensing research, development, and commercialization must be made and mechanisms for cooperative research and development be established.

Thirdly, in the area of cooperative research, I point to the NASA-GEOSAT joint test case program. It is a $10 million voluntary effort which took place over 7 years which has been finally published this month.

I want to state that such a cooperative voluntary effort would be difficult to accomplish today under NASA's basic science only mandate from the current administration.

Fourth, we believe that a more effective Government-private sector advisory committee, perhaps modeled on the Solar System Exploratory Committee, should be created, and in any case an ongoing Government private sector advisory oversight forum such as a board commission or whatever, must be established to help implement a national plan, and the further development of remote sensing technology.

A second major area, that has been touched on by a number of the other speakers this morning, on which we have major concern is access to experimental data, particularly under sections 502 and 503. Our position has been spelled out and detailed in the exchange of letters with Dr. Beggs, Administrator of NASA. They are included in documents submitted for the record.

Specifically, a position paper by the GEOSAT Committee entitled *Civil Access to NASA's Experimental Satellite Remote Sensing Data In View of the LANDSAT Commercialization Act* in which, among other things, basically we requested that PI type data be submitted researchers at the same time as it is given to the principal investigators to the EROS data center for use by other non-Government.

Specically in this area we would like to request that your Committee look to the act at potential changes and review how that the current principal investigator policy might be expanded to expedite the availability of experimental data to a greatly broadened group of investigators. We believe this will significantly increase the potential value of such data from both the scientific point of view as well as the potentially commercial point of view.

In this context, we support industrial research activities associated with the Archive at the EROS Data Center under discussion previously. I would be glad to answer questions about our view of how that might be more workable than at the present time.

Also, specifically we would like to recommend that under the present or expanded guidelines, bonafide organizations for remote sensing such as the GEOSAT Committee might be established as primary on-going investigators for systems related to their fields of interest.

In summary, regarding experimental data access, we believe that while experimental remote sensing missions conducted by the Federal Government should not be designed operated, nor data distributed by the Federal Government in such a manner as to compete with any U.S. designated owner or operator licensee under title V, mechanisms must be put in place and coordinated with the designated U.S. owner-operators and licensees that would allow access to experimental data for R&D, and I have included the word "evaluation" purposes by bona fide Government, university, and private sector researchers.

It is this area of evaluation of such data that is critical to whether we will ever use it in a commercial mode.

I do not have time to repeat a number of our concerns about potential risks to EOSAT. We recognize the existence of EOSAT Corporation is the end product of a long process that goes back at least to PD-54 and the Carter administration.

The fundamental issue here has always been supported by the GEOSAT Committee that is, the continuity of an U.S. earth observation system, and we laud the efforts of the Senate and House Committees to provide such continuity for such a system.

Specifically, we would like to suggest that the role of NASA supported multi-line array focal plane type research which has been curtailed in the commercialization process be reviewed because we believe that that kind of development by Government in support of the commercial activities are important in the United States to maintain the U.S. position internationaly in competition with the rest of the world.

Finally, as mentioned before we are concerned about the possibility that other countries may not in the future follow the concepts of the open skies policy of discriminatory access to data, and we urge your continued review of that problem.

In conclusion, the GEOSAT Committee applauds the efforts of the Senate and House Subcommittees and full Committees which have led up to the LANDSAT Act of 1984. The GEOSAT Committee encourages Congress to maintain its vigilence over these issues by continued hearings of this type to review the development and implementation of a unified national plan and for the successful commercialization as intended by the LANDSAT Act of 1984.

Thank you, sir.

[The statement follows:]

STATEMENT OF DR. FREDERICK BRADLEY HENDERSON III, PRESIDENT, THE GEOSAT COMMITTEE, INC.

Mr. Chairman and Members of the Subcommittee

I am pleased to have the opportunity to appear before the subcommittee today to review the current status of the implementation of the "Land Remote Sensing Commercialization Act of 1984" -- PL 89-365 ("The Landsat Act") on behalf of the Geosat Committee, Inc. The Geosat Committee is a not-for-profit organization supported by 75 companies utilizing satellite remote sensing in geoscience, engineering, and environmental applications for energy and mineral exploration and development and engineering projects worldwide. Through its developing renewable resources and ocean sensing applications working groups, The Geosat Committee also represents some users of satellite remote sensing in these disciplines as well.

In general, most members of the Geosat Committee believe that the Landsat Law is a good law and in general shouldn't be prematurely amended at this time. The EOSAT Corporation has only just signed its contract with the Department of Commerce (DOC) and needs reasonable time in which to set its own operating policies and commence operations.

There are, however, some areas of concern to The Geosat Committee with respect to initial efforts to implement the Landsat Law. These areas include:

1. The development of a unified national plan for remote sensing research and development;
2. The creation of an on-going government-private sector advisory and/or oversight body to assist in the implementation of such a plan;
3. Private sector access to experimental remote sensing data now and under a future unified national plan; and,
4. Possible risks to the successful commercialization of Landsat programs.

A UNIFIED NATIONAL PLAN FOR REMOTE SENSING RESEARCH AND DEVELOPMENT

Section 501.(3) of PL 98-365 requires that:

> (e) The Secretary and the Administrator of the National Aeronautics and Space Administration shall, within one year after the date of enactment of this Act and biennially thereafter, jointly develop and transmit to the Congress a report which includes (1) a unified national plan for remote-sensing research and development applied to the Earth and its atmosphere; (2) a compilation of progress in the relevant ongoing research and development activities of the Federal agencies; and (3) an assessment of the state of our knowledge of the Earth and its atmosphere, the needs for additional research (including research related to operational Federal remote-sensing space programs), and opportunities available for further progress.

The Geosat Committee was privileged to be among the NASA-NOAA invited reviewers of the initial (June 1985) and subsequent review (September 1985) drafts. Our comments and questions with respect to the June draft apply also generally to the September draft and are appended hereto in a letter to George Ohring and Ray Arnold of NOAA and NASA dated 20 June 1985.

Most of our concerns regarding the development of a United National Plan for Remote Sensing are institutional in nature and won't be repeated herein. They relate largely to issues of agency authority or charters for segments of the plan, implementation of the plan, user interface with the plan and the role of commercialization with respect to the plan.

We commend NASA and NOAA for their efforts to comply with PL 98-365 with the drafts developed so far. We also recognize that many pertinent advisory recommendations in reports such as the Earth System Science Committee (ESSC) and Space-Applications Advisory Committee (SAAC) and the National Research Council's Space Applications Board (SAB) are forthcoming in 1986 and are yet to be incorporated in the ongoing development of a unified national plan. Similarly, we hope that the research objectives of the recently concluded Fifth Geosat Flagstaff Workshop ("Remote Sensing: Goals and Directions for Research and Development," 4-8 November 1985, Flagstaff, Arizona) will similarly be considered when published, also in early 1986, for inclusion in the United National Plan.

Some of the concerns and recommendations of The Geosat Committee are included in the appended Keynote Address to the Fifth Geosat Flagstaff Workshop entitled "Remote Sensing: The Need Government-Private Sector Partnerships in Research and Development" by John H. McElroy (4 November 1985). Specifically, the Geosat Committee recommends consideration of the following:

1. To be meaningful, the United National Plan must have the support of the executive branch of the Administration in addition to the authority already established in PL 98-365 and the technical capabilities of NASA and NOAA and other pertinent agencies.

2. Clear definition of the roles of the government, private sector, and academia as they relate to remote sensing research, development, and commercialization must be made and mechanisms for cooperative research, development and commercialization be established. At present, a huge gap appears to exist between acceptable government exploratory, high risk, low payoff potential research (or basic science), and acceptable private sector operational, low risk, high pay-off potential research (or applied science). This gap would appear to include R&D concepts acceptable in the past such as "applications R&D," "technology demonstration," and "technology transfer, and in general, the "development" in "research and development."

   Mechanisms must be established to close this gap between basic science and applications of satellite remote sensing in order to justify ongoing government basic research programs (especially during high budget deficits), adequately support joint government-private sector development of the uses of basic government research, and allow justifiable commercialization of these uses of remote sensing. Such eventual commercialization will provide a return on taxpayer investment in government basic research and benefit the economy in general and the people as a whole.

3. Cooperative research and development between government and the private sector with support of academia must be encouraged. The joint NASA/GEOSAT Test Case Project (Executive Summary hereby submitted) was conducted 1977 to 1982 and has just been released to the public. This $10 million dollar voluntary, no money exchanged program would be difficult to create today under NASA's basic science-only mandate from the current administration.

However, it is just such joint cooperation research and development programs that are needed to justify basic government satellite remote sensing research and to facilitate the ultimate commercialization of such systems. Authority for such cooperative application research and development is clearly stated in Sections 501.(a)(1) and (2) for NASA and Sections 501.(b)(1), (2), and (3) for NOAA in PL 98-365.

4. An effective government-private sector advisory committee modeled after the successful Solar System Exploration Committee (SSEC) should be created. Such a committee is recommended by John H. McElroy in his appended keynote address to the Fifth Geosat Flagstaff workshop. This committee would develop a long-term R&D strategy and plan for applications programs. To be effective it should be supported by Congress and advise NASA NOAA, The Executive Branch, and Congress independent of prior budget review processes.

5. As a result of recommendations of the above advisory committee or concurrently with its deliberations, an ongoing government-private sector advisory/oversight forum (committee, board, commission, etc.) should be established. Such an ongoing forum is needed to help implement a united national plan and to further the development of satellite remote sensing technology in support of the continuity of a U.S. civil earth observation program.

6. Finally, until such time as independent advisory bodies such as described above are formed, bona fide remote sensing organizations such as The Geosat Committee should be made part of the formal review process for the development of a unified national plan. Even more important, we urge Congress to continue hearings such as these so that the Unified National Plan is developed openly in the public view.

ACCESS TO EXPERIMENTAL DATA

The Geosat Committee basically supports the Landsat Law (PL 98-365) but we do have some serious reservations with respect to access to experimental data under Sections 502 and 503 as interpreted by NASA and perhaps others. Our position regarding access to experimental data is included in an appended exchange of letters between The Geosat Committee and Mr. Beggs, Administrator of NASA. The basis of our interest in broadening the user community access to experimental data is included in our letter (18 June 1985) to Mr. Beggs and is entitled "Civil Access to NASA's Experimental Satellite Remote Sensing Data in view of the Landsat Commercialization Act, Public Law 98-365: A Position Paper of The Geosat Committee, Inc. (appended). Mr. Beggs' letter (30 July 1985) in response, presumably is based on NASA Counsel's interpretation of Sections 502 and 503, and is not satisfactory to The Geosat Committee.

Let it be clearly understood that The Geosat Committee in no way wishes to jeopardize the Congressional intent to protect owner/operator from competition from government experimental systems or from unscrupulous private sector abuse of access to experimental data under any mechanism.

However, the current Principal Investigator evaluation program employed by NASA is generally unacceptable to most Geosat Committee members because of public dissemination, an other problem contractual requirements. The Geosat Committee seeks to broaden this evaluation process by simultaneously placing principal Investigator data on public file at the EROS Data

Center. This approach was ruled inappropriate in Mr. Beggs' letter based on NASA's interpretation of "commercial use" and "enbloc sales requirements" of Sections 502 and 503 of PL 98-365.

The Geosat Committee believes that broadening the access to experimental data to include experimental data evaluation by bona fide private sector and other end users will significantly increase potential value of such data from both a scientific and a potentially commercial point of view. The user community represented by The Geosat Committee includes scientists as sophisticated in satellite remote sensing data evaluation and use as any in the government or academic sectors. There is a pressing need for applications model development both in private sector as well as in government and academia. Long evaluation lead times in the private sector are required before commercial utility of such data can be determined. Such evaluations must be accomplished "inhouse" by the private sector user as well as by "government funded research and development programs."

In addition, it would appear that NASA's interpretations of experimental data distribution under Sections 104, 502, and 503 may be inconsistent with the authorities for cooperative research between NASA, NOAA, and other federal agencies, and the academic and the private sector communities in Section 501. The Geosat Committee is not competent to advise whether amendments to the law, technical or otherwise, are needed. But we do encourage Congress to review provisions in Sections 502 and 503 with respect to our concerns regarding greater access to experimental data. Specifically, we request your consideration of the following:

1. The current Principal Investigator policy be expanded to expedite the availability of "experimental data" to a greatly broadened group of investigators, including private sector users.

2. That specifically, The Geosat Committee and other bona fide satellite remote sensing user organizations be established as standing primary investigators for systems relating to their fields of interest (Geosciences).

3. That government policy recognize that early access to experimental data would provide early feedback and evaluations (as proposed in the appended Geosat letter to Mr. Beggs) of the foremost scientists in the private sector community (e.g., The Geosat Committee).

4. That current NASA interpretations of Sections 502 and 503 if continued and applied to future NASA and NOAA programs, especially those proposed under a unified national plan, could severely restrict acceptance of such programs by the taxpaying user community. Such lack of user acceptance might prove detrimental to funding such programs by OMB and Congress. The Geosat Committee believes that the road to an acceptable unified national plan is through cooperative rather than restrictive experimental data access policies.

5. In summary, we believe that while experimental remote sensing missions conducted by the federal government should not be designed, operated, nor data distributed by the federal government in such a manner as to compete with any U.S. designated owner/operator or licensee under Title 5, mechanisms must be put in place and coordinated with designated U.S. owner/operators or licensees that will allow access to experimental data for R&D and evaluation purposes by bona fide government, university and private sector researchers.

EOSAT AND RISKS TO THE IMPLEMENTATION THE LANDSAT LAW - PL 98-365

The Geosat Committee recognizes that the recently signed contract between The EOSAT Corporation and The Department of Commerce is the present result of a long-time process leading to the commercialization of the Landsat Program. This process extends back at least to the "Integration" and "Privitization" Studies of the Carter Administration which culminated in Presidential Directive 54 of 1979. All of these historical events have dealt with one main issue, the continuity of a U.S. civilian earth observation system which is strongly supported by the Geosat Committee. This process has proceeded in spite of some governmental obstructions, intentional or otherwise. These include military resistance to or limitations placed on such a civil program. OMB's recent efforts to curtail or eliminate such a program if it fails to prove itself commercial viable in spite of enduring public good that can be derived from such a system. And finally, in the recent contract negotiations, further government supports for multi-line array focal plane research and development as well as funds for other next-step technology developments for Landsat 6 and 7 were denied by the Administration. This action was taken in spite of its potentially detrimental effects on EOSAT's ability to compete internationally with advanced systems subsidized by other governments.

In view of the above, the Geosat Committee encourages Congress to continue to review the implementation of the intent of the Landsat Law in general and specifically with respect to the following:

1. Review the role of NASA supported multi-line array, focal plane research and development and its importance to the continued development of U.S. satellite remote sensing technology.

2. The Geosat Committee strongly maintains its long-term support of the U.S. Open Skies Policy of nondiscriminatory access to data. We are concerned with periodic references to the possibilities that other governments may develop systems and policies which do not comply with the U.S. Open Skies Policy, especially as enunciated in PL 98-365. We urge the Congress and the Administration, through the Department of State or other appropriate agencies, to review any such risks for U.S. commercial remote sensing efforts and to encourage foreign government compliance with the U.S. Open Skies Policy. We believe that the development of complementary and compatible satellite remote systems with full reciprocity of nondiscriminatory data access by the United States and her allies and trading partners is in the best interests of all concerned.

CONCLUDING COMMENTS

The Geosat Committee applauds the efforts of the Senate and House subcommittees and full committees which have led up to the Landsat Act of 1984 (PL 98-365). Your efforts have done more to protect the interests of the taxpaying private sector, both the user community and the general public, than any other efforts to support the commercialization of the Landsat Program and to provide continuity of a U.S. civil earth observation satellite system.

The Geosat Committee encourages Congress to maintain its vigilance over these issues by continued hearings of this type to review the development and implementation of a unified national plan for satellite remote sensing and its successful commercialization as intended by the "Landsat Law" of 1984.

Dr. ARVIDSON. I am here representing the university-based research community, not the community that tries to find mineral deposits or oil deposits directly from LANDSAT, but a rather nascent community that is beginning to look at the earth as a planet. There are fundamental scientific questions to learn about earth as a planet.

We are just beginning to do examine Earth as a planet. Hopefully the approach will really become an extensive field of endeavor in the next decade, with the polar platforms, the platforms associated with the space station complex.

What I would like to do in my five minutes is to point out some of the science that can be done incorporating remote sensing data; secondly, point to the fact that TM provides the initial data sets to get us to learn how to treat earth as a planet. Therefore LANDSAT data are very important to the basic research community. Third, I would like to talk about what my real concern is, and that is what does commercialization mean in the next decade, when there are platforms and very sophisticated complements of experimental, operational, and commercial systems in orbit?

There are a number of fundamental things that can be learned about the earth as a planet. We have yet to launch a mission to earth to understand how earth acts as a system, how it has evolved as a system. There are problems associated with global climate where we must have global measurements of the atmosphere, the oceans, and land surfaces to begin to solve.

There are important science questions over the longer term, climate measured over tens of thousands of years. Information is contained in the distribution of surface materials on the land that tell us about past climates. For instance, in a recent Space Shuttle flight with the large format camera, a whole series of relict beaches were found in lakes on the Tibetan Plateau. These features provide a record of rainfall over tens of thousands of years.

If one also looks at the record on the land surface, written in the record, exposed at the surface, is the history of the evolution of the continents, that is, how continents have been assembled over time. In a recent LANDSAT thematic mapper study, for example, large slivers of oceanic crust were found in the eastern desert of Egypt. These slivers demonstrate that that crust was assembled by convergence and collision of older continents. Pieces of ocean crust have been left essentially as remnants, squeezed between preexisting continental fragments.

The Egyptian work used LANDSAT thematic mapper data. These data are beginning to give us a regional to global perspective as to how the earth has been put together and works as a system.

Surprisingly, we have yet to launch missions that are dedicated to scientific, global observations of the earth. The only operational system, the only system that we have in orbit are operational systems, including LANDSAT.

LANDSAT thematic mapper data are crucial to getting us ready to deal with the kinds of data sets we expect in the next decade from the sophisticated instrumentation that may fly on the platforms. And, therefore, access to the LANDSAT data and sharing of data is crucial to this nascent research community beginning to examine Earth as a planet.

Commercialization should not stand in the way of utilizing LANDSAT data. We simply at present do not have the funds to acquire data from EOSAT or to share data. Funds in excess of some $3 million are needed this year just to support the community's data needs. We do not have the funds at present within the university scale research budgets. So we need money. That is the short term problem.

The problem that I am most concerned with, however, deals with what we do in the polar platform era. The unmanned platforms are looked upon with great anticipation. The National Academy of Science's Space Science Board is looking at plans for missions to earth that include the platforms. The Earth Systems Science Committee within NASA likewise is looking to platforms to provide the fundamental research data needed to attack earth as a global system.

During the platform era, data sets from advanced sensors need to be widely distributed and they need to be widely shared. Those are basic tenets of academic or basic research, and it would be unfortunate indeed if the research data sets from the advanced sensors in the platform era were subjected to the same costs and restraints that we have levied upon us for the LANDSAT thematic mapper.

So let us be careful in the next decade to separate research from operational from commercial uses, and let us not rush into commercialization of instruments before there is a need and demonstrated viability for commercialization.

Thank you.

Senator GORTON. Thank you.

Dr. Spriestersbach.

Dr. SPRIESTERSBACH. Thank you for giving me the opportunity to discuss with you the importance of the data generated by this program and by its use within the academic community.

I might observe that I am a vice president for research and dean of a graduate college of a typical research university. This is not my field. Therefore, my statements I think will possibly represent the general statements of institutions of my type and the concerns that we would have from an institutional level.

Certainly scientists in the academic community have watched with great interest the growing national commitment to a land remote sensing satellite program, because there is, as has just been indicated, ample evidence that remote sensing technology has great potential to monitor the earth and its environment.

Public Law 98–365 ensures that the information acquired by means of this technology will not be lost to future generations. In considering the process of commercialization, it is my sincere hope that ways will be found to assure that scientists from the academic community will be allowed access to data in a timely fashion and at low cost.

It is also crucial that university-based researchers have access to data in the proposed archive. While commercialization seeks to build upon and market discoveries already made, university research ensures that there will be new discoveries in the future.

Universities are especially interested in those aspects of P.L. 98–365 addressed by titles V and VI, since title V requires and authorizes Federal agencies to conduct continued programs of remote sensing research and development and title VI requires long-term preservation by the Federal Government of land remote sensing satellite data.

Future scientists must be able to build upon the substantive and methodological foundations of the past and present. Using these data, they will advance the frontiers of knowledge and application in ways we cannot even guess at now.

As you know, the data from this technology are particularly important to that group of disciplines known as the earth sciences. The goals and objectives of this group of sciences are designed to develop fundamental scientific knowledge enabling us to understand the dynamic interdependence among the earth's land masses, oceans, and atmosphere, and how this system in turn controls the current state of the environment and its prospects for the future.

The University of Iowa as a large public educational institution has major programs of undergraduate and graduate teaching, research, and public service which are driven by advanced scientific data, including that acquired through remote sensing technology. This information and the technology used to acquire, process and generate the data will have implications for a broad range of scientists, including those in geology, geography, biology, civil engineering, environmental research, hydraulics, atmospheric research, data systems and processing, data analysis, and interpretation.

While we at Iowa do not have a major center or laboratory focusing on remote sensing technology, we have substantial need for information made available through this technology. In this respect, the University of Iowa may be somewhat typical of colleges and universities across the country, in that we have an interest in the technology and a need for the data it can provide, but presently lack equipment and facilities to process and analyze these data.

It follows that we have serious concerns about the possible high cost of data generated by it and the prospect for related Federally supported research and development programs at universities. The University of Iowa also supports the creation of a remote sensing data archive to preserve these materials for future education and research. In addition, we endorse the concept of a Federal remote sensing research and development program, located with the historic archive, that would allow for university participation.

This arrangement would facilitate access by participating faculty, staff and graduate students to already existing data processing and analysis, equipment and facilities, and would provide new opportunities for faculty, staff, and graduate students to participate in research and development identified and designed by program staff.

At the same time, the program should provide university-based researchers with a source of data which would support their university-based R&D activities.

In conclusion, the University of Iowa has been and will continue to be a participant in the development of space science and technology, including land remote sensing. A historic archive of repetitive global data and of Federally sponsored R&D programs would be beneficial to us, as it would be to many other universities, and to the future success of this national program.

Thank you for the opportunity to make this statement.

[The statement follows:]

STATEMENT OF D.C. SPRIESTERSBACH, VICE PRESIDENT FOR EDUCATIONAL DEVELOPMENT AND RESEARCH ON BEHALF OF THE UNIVERSITY OF IOWA

My name is Duane C. Spriestersbach. I am Vice President for Educational Development and Research at the University of Iowa. I consider it an honor to have the opportunity to discuss with you the importance of the data generated by the land remote sensing satellite program and its use by researchers now as well as in the future.

Scientists in the academic community have watched with great interest the growing national commitment to a land remote sensing satellite program. Beginning with the early experiments from the Gemini and Apollo platforms, to the Landsat projects, to present-day programs and experiments in both public and private sectors, there has been ample evidence that remote sensing technology has great potential to monitor the Earth and its environment. Public Law 98-365 ensures that the information acquired by means of this technology will not be lost to future generations.

I understand that the major intent of this act is to establish a framework for the commercial marketing of Landsat data and to transfer the responsibility for development and operation of future land remote sensing satellite systems to the private sector. In considering the process of commercialization, it is my sincere hope that ways will be found to ensure that scientists from the academic community will be allowed access to data in a timely fashion and at low cost. Recognizing that the intent of commercialization is to develop markets to enhance the use of these data and to reduce federal expenditures, it is also crucial that university-based researchers have access to data in the proposed archive. While commercialization seeks to build upon and market discoveries already made, university-based research ensures that there will be new discoveries in the future.

Universities will be most interested in another secondary, but nonetheless important, aspect of P.L. 98-365 addressed by Titles V and VI. These titles are most important since Title V requires and authorizes federal agencies to conduct continued programs of remote sensing research and development and Title VI requires long-term preservation, by the federal government, of land remote sensing satellite data. Both of these functions are crucial to future scientific research, Future scientists must be able to build upon the substantive and methodological foundations of the past and present day. Using these data, they will advance the frontiers of knowledge and application in ways we cannot even guess at now. In this respect, these hearings will have a vital role to play in the advancement of scientific knowledge and the great national resource it represents.

As you know, the data from this technology are particularly important to that group of disciplines known as Earth Sciences. The goals and objectives of this group of sciencies are designed to develop fundamental scientific knowledge enabling us to understand the dynamic interdependence among the Earth's land masses, oceans, and atmosphere and how this system in turn controls the current state of the environment and its prospects for the future. It is a line of inquiry known for its reliance on basic research at the forefront of contemporary science as well as for its immediate impact upon economic and national security concerns.

The University of Iowa, as a large public educational institution, has major programs of undergraduate and graduate teaching, research, and public service which are driven by advanced scientific data, including that acquired through remote sensing technology. We have had long-standing involvement in space science and technology, including most prominently the work of Professor James Van Allen and his colleagues. Yet we have other programs which benefit from the data acquired by land remote sensing technology. This information and the technology used to acquire, process, and generate new data will have implications for a broad range of scientists, including those in geology, geography, biology, civil engineering, environmental research, hydraulics, atmospheric research, data systems and processing, data analysis, and interpretation.

Faculty members from our Department of Geology have been involved in research associated with the first Landsat and Skylab projects. Currently there is a semester-long course in geologic applications of remote sensing technology which serves as a basis for virtually every field study conducted by our faculty and graduate students. In this sense this technology is a central part of our ongoing program of geologic research and teaching. One graduate student is now using remote sensing images to study underlying geologic units and substructures beneath the tropical botanical canopy of Indonesia. He will build upon the techniques and information of this study in the decades ahead. Other University scientists have used this technology to study the effects of acid rain and other phenomena in the environment.

In summary, University faculty and staff fully recognize the advancements that have been made in the science and technology of Earth remote sensing during the past decade and the significant contributions that the application of these data has made in the solution of many Earth resource problems. At the same time, we firmly believe that the full potential of these data and technology, as it relates to the solution of Earth-based problems, is far from realized. This potential will be realized only with future investment in research and development.

While we have no major center or laboratory focusing upon remote sensing technology at the University of Iowa, we have substantial need for information made available through this technology. Therefore, we seek opportunities to participate in advancing the science and technology of remote sensing and advancing man's understanding of the Earth and its processes through the application of this knowledge.

In this respect the University of Iowa may be somewhat typical of colleges and universities across the country in that we have an interest in the technology and a need for the data it can provide, but presently lack equipment and facilities to process and analyze these data. We have serious concerns about the high cost of data and the prospect for federally supported research and development programs at universities. Without such support, little progress will be made toward applications development in areas of high risk, and fewer new qualified researchers will enter the workforce.

The University of Iowa also supports the creation of a remote sensing data archive to preserve these materials for future education and research. Such a resource is of vital importance to promoting future Earth research and development as well as to the advancement of science.

We endorse the concept of a federal remote sensing research and development program located with the historic archive that would allow for University participation This arrangement would facilitate access by participating faculty, staff, and graduate students to already existing data processing and analysis equipment and facilities. New opportunities would be provided for faculty, staff, and graduate students to participate in research and development identified and designed by program staff. At the same time, the program should provide university-based researchers with a source of data which would support their university-based R&D activities.

In conclusion, the University of Iowa has been and will continue to be a participant in the development of space science and technology—including land remote sensing. A historic archive of repetitive, global data and a federally-sponsored R & D program would be beneficial to us as it would be to many other universities and to the future success of this national program.

We endorse these initiatives because they will have a major influence on our ability to conduct research and to educate students who will be the users of this technology in the coming decades.

Thank you for this opportunity to speak on behalf of this issue.

Senator GORTON. Thank you, doctor.

Senator Riegle would like to introduce the next witness, who is from the State of Michigan.

Senator RIEGLE. Thank you, Dr. Chairman.

I do want to make a brief statement to welcome Dr. Holter to the committee today.

In many ways, LANDSAT would not have achieved the success it has without the efforts of ERIM and other companies which have created new markets for the data which LANDSAT has generated. Dr. Holter and for that matter other members of the committee represent the community most responsible for increasing in a very short period of time our knowledge and understanding of our planet. With the LANDSAT system, we are now able to see more fully the complex interrelated world that we live in.

To most people in the remote sensing community, Marvin Holter needs little introduction. He has been a leader in remote sensing since 1947, when he joined the Willow Run Laboratories of the University of Michigan, and holds three degrees from the University of Michigan, whereas I only hold one. I am very proud of mine, so you must be three times as proud of yours.

But since that time he has had varied experience in the management of multidisciplinary research, management of earth observation programs, and the teaching of remote sensing courses, and has of course authored many technical papers, two books, and has participated in an advisory capacity in other scientific and national security areas.

So I am delighted that he is here representing that kind of experience. He has great standing in the field, as well as representing a very fine entity that we feel we have in the State of Michigan.

Senator GORTON. Mr. Holter, you may proceed.

Mr. HOLTER. Thank you, Senator, and Mr. Chairman and members of the committee.

It is a pleasure to be here to make some remarks on this topic. I would like to identify eight issues which seem to me to be important. They are not the only important issues and other people have addressed others, but these are eight that occurred to me.

The first issue tends to support all the rest. For a whole host of reasons, some of which are written in the written testimony and I will not repeat them here, I believe it is very important for the Nation to maintain a presence in Earth observations with the LANDSAT system.

The existing EOSAT contract may or may not be the best way to do this, but it is the way that has been chosen, and I believe we all ought to support it and try to make it work and, if there are deficiencies in that contract, work to fix them. The past is behind us and it is very important to make this effort work.

Issue number two: As I understand the contract, under certain circumstances if the EOSAT revenues do not materialize as expected, the EOSAT Corporation has the option to withdraw from the contract, although they must complete the fabrication of LANDSAT's 6 and 7.

I believe the community, the value added business community and the user community, needs some more clear assurance that, should that happen—we hope it will not, but should it happen—that the U.S. Government is prepared to launch and operate those systems. There is a good reason for this.

In order for the market to develop, the value-added people and the users must make substantial commitments and investments, and the continuity of data is very important to those decisions, and those decisions will be impacted unfavorably if there's any uncertainty about the data continuity.

The third issue—and this is the central issue in the LANDSAT EOSAT contract—how can the LANDSAT commercialization effort be best conducted to achieve two things: First, we have to find a way to make the EOSAT Corporation profitable; but in the process of doing that, we must also provide the means to make it attractive for the value added people to set up a lot of value added firms.

I think a previous speaker referred to the fact that the market is disaggregated. It will not be aggregated in the future. Each market segment has different needs. The best way to develop that market is to have a large number of value added firms, each specializing in his own niche.

This gets at the question of how the two segments, the EOSAT and the value added people, will generate their funds. It has been proposed in the contract that EOSAT sell raw data, whatever that is, and the value added business get their revenues from further processing of the data. There is a big grey area in there that is not worked out well. I hope we can work it out well, but I think we should recognize in advance that that may not turn out to be a workable way to do it.

And it is possible—I do not recommend this, but it is possible that downstream we may have to consider allowing EOSAT some small royalties on value added work or some other mechanism. I merely want to point out that I see a potential problem here that we need to be sensitive to as we go along and be prepared to react to it.

Issue four: What should the U.S. do if foreign governments subsidize their LANDSAT-like systems to the degree that it threatens the viability of a commercial LANDSAT operation? We need to be prepared for that eventuality and be prepared to do some government to government negotiation.

It may even be necessary at some time to consider other subsidies if that is the only way that we can get a U.S. system in operation. That is an issue that we will have to keep our eyes on in the future.

Issue five: How do we avoid U.S. Government agency value added activities from interfering with the development of the market? As of today, I believe the biggest single identifiable market for LANDSAT data is the collection of U.S. Government Federal agencies. There is a tendency in all these agencies to want to do it in-house, and I understand that. It is natural.

However, that is such an important market segment at this time, I believe we need to be sensitive to encouraging the Government agencies to do as much of that work as may be appropriate, with the private value industries to build up that private segment.

Issue six: The NASA-NOAA role in performing research and development, which some legislation mandates. NASA and NOAA are developing plans, and I agree that they are good plans. There are some details in which they are not coupled well enough into the needs of EOSAT and commercial LANDSAT. I will mention just one.

The next generation of instruments of the multi-spectrum scanner sort will use multilinear arrays and, due to budget considerations, as far as I know the multi-linear array program in NASA is not funded at the moment, and at least in that detail they are non-responsive to the needs for the next generation in LANDSAT.

Issue seven has been mentioned before: Competition to commercial LANDSAT from free data generated by Government experimental systems. It is a very complicated issue and in some cases those data may help LANDSAT and sometimes it may hurt it. There is a lot of work needed to understand that issue and to react appropriately to it.

The last issue is, it is clear that these LANDSAT systems are global in nature, just like communications systems and meteorological satellite systems. It is also clear that, particularly in the renewable resource area, that one satellite probably isn't optimum by a long shot. There is a big need, as yet as far as I know unaddressed, to begin some conversations with other nations which put up similar systems to standardize the data formats, have some sort of standard quality control, and to coordinate the orbits to maximize the amount of coverage we get. So I would encourage some consideration of that.

[The statement follows:]

STATEMENT OF MARVIN R. HOLTER, EXECUTIVE VICE PRESIDENT OF THE ENVIRONMENTAL RESEARCH INSTITUTE OF MICHIGAN

Mr. Chairman and Members of the Subcommittee, it is a pleasure and an honor to have the opportunity to present some of my views concerning issues related to participation of the private sector in civilian operational remote sensing. The views I will present are mine and ERIM's but I believe they are shared, in large part, by a substantial part of the value added service community. To provide some background for my remarks let me begin by briefly reminding the committees of the history of the Environmental Research Institute of Michigan (ERIM).

ERIM was formed in 1946 in the University of Michigan to do contract research. In 1973 it separated from the University to become an independent, State of Michigan endorsed, non-profit contract research center. This year ERIM will do approximately $35,000,000.00 of research and service work. The principal focus of ERIM's activities has been, and continues to be, military reconnaissance and civil remote sensing. In about 1960, under U.S. Army funding, the multispectral scanner and associated data processing were invented and first implemented by myself and others at ERIM. These are now the principal sensor and associated data processing employed in the Landsat civil remote sensing system. The earliest mention of the use of MSS systems in space were made by myself and others in the 1963–64 period in unsolicited proposals to NASA and others and in a number of technical papers written and published during that period. Since that time ERIM has been involved in the development and application of civil remote sensing with NASA, other federal agencies, state and local agencies, private concerns and with foreign governments and institutions. Thus ERIM was the earliest private institution involved in remote sensing preceding NASA's interest and played a leading role in getting NASA involved in remote sensing. ERIM's activities span the range of sensor and data processing R&D, applications development, technology transfer including instructional and training activities, provision of value added applications services, host and manager of the International Remote Sensing Symposia, etc. In 1978 ERIM created a division under Vice President Donald Lowe to pursue remote sensing applications. Thus ERIM's views arise from a long history of R&D in all phases of remote sensing, from a substantial involvement in value added services for user organizations and from a significant involvement with foreign agencies in providing international services and technology transfer. ERIM is not a commercial equipment manufacturer nor is it the type of organization that could or would want to operate the large, complex satellite and related communications data generating system. Therefore, its views relative to the data generation system will be those of a use of the data product rather than those of a system operator.

Civil remote sensing activities fall into three broad classes: data generation, value added services and users of the data as modified by the value added services. Under data generation I would include the space segment and those ground functions required for receiving, archiving, reproducing, and distributing the basic data products. Although there may be some minor quibbles over details, I believe it is quite generally agreed that the data generation part of the overall system must be under unified management. Therefore any private sector involvement will consist of a single very large entity such as a large aerospace or communications company operating the data generation segment under government supervision and regulation. In this the data generation segment is very different from the user and value added service segments.

The potential user segment, on the other hand, is now, and almost certainly will remain, extremely diverse numerically and qualitatively in its technical sophistication and ability to use more or less refined information products derived from the data. At the one extreme we have a few federal agencies, oil companies, universities, etc., capable of accepting the new data and processing it in very sophisticated ways to derive very complex and refined information products. At the other extreme we have non-technical individual private citizens some of whom will buy a single frame of unprocessed pictorial imagery of the area where they live as a curiosity or novelty and not understand fully the reason for the unusual color coding but enjoying the bright colors. Between these two extremes all graduations exist in the U.S. state and local public agencies, private commercial organizations and foreign private and governmental organizations. The point is that the users are, and will continue to be, very diverse in technical capabilities and very numerous, i.e., unaggregated.

Because of their wide diversity in numbers and capabilities each of the many present and potential users will require a more or less different and distinctive method of coupling into the data generation segment. The coupling mechanism is what is called the value added services segment. The value added services function is best carried out by a multiplicity of organizations of diverse character each well matched to some subset of the total users. This is especially true during the early years when potential users are being introduced to the new data and information products. The diversity and agility and initiatives required can clearly be best met by a multiplicity of diverse private organizations. It is in the interest of the government to encourage the creation and viability of this multiplicity of diverse private institutions.

Attached to this testimony are copies of two articles from NASA document NASA SP4005 "A Spacefaring People" which contains relevant background material. The article by Pamela Mack briefly contrasts the differences between the space communications and weather satellite programs and the remote sensing programs. These differences are important to commercialization of Landsat. The article by John Logsdon traces the history of U.S. space policies over the course of the U.S. Space Program and these are relevant to Landsat commercialization.

In what follows, a series of issues will be identified which will be important in the development of Landsat commercialization. Some of these issues are important to U.S. Government oversight of the EOSAT contract, some will require government action and some will require joint negotiation and accommodation between EOSAT and a multitude of value added firms.

ISSUE 1

It is important in several respects for the U.S. to continue to maintain a presence and leadership in satellite observations of the Earth.

The existing EOSAT contract may or may not be the best way to achieve Landsat commercialization but it is the way that has been selected so it must be supported vigorously by all involved. A U.S. presence in remote sensing is important for the nation in a host of civil and national seurity ways. The prestige of the U.S. and its image in the eyes of other nations would suffer if the U.S. backed away from remote sensing after exhibiting admirable leadership in developing the technology and getting the entire world interested in it. It is important in managing U.S. resources, in providing information on agriculture and environmental activities of other nations as they may affect U.S. actions and in helping ensure access to similar data generated by other national systems such as the French SPOT. Without the existence of a U.S. system practicing the U.S. policy of universal equal access to such data other nations may not be so willing to provide open and equal access to the data generated by their systems.

ISSUE 2

If EOSAT revenues do not materialize as expected and they take advantage of the contract provision permitting them to withdraw will the U.S. Government launch and operate Landsat 6 and 7 providing continuity of data availability?

In order for the market to develop, users and value added firms must make substantial investments. Any uncertainties about continuity of data availability will inhibit these investment and commitment decisions and delay market development. Some more concrete indication of U.S. Government intentions, should EOSAT exercise their withdrawal option, would encourage these commitment and investment decisions.

ISSUE 3

How can the Landsat commercialization effort be best conducted to simultaneously permit EOSAT to be profitable and at the same time encourage and permit the formation and profitable operation of the required wide spectrum of value added firms?

Achievement of both of these objectives is necessary for a successful Landsat commercialization. EOSAT must, of course, develop a means of becoming profitable. However, this by itself is not sufficient. The potential spectrum of user communities is so diffuse and differentiated that market development will require a broad spectrum of value added firms each specializing in its own niche. If EOSAT or any other single organization attempts to capture the bulk of the value added business, market development would not be nearly so well served and as a consequence would be delayed. For some time to come EOSAT will be operating under a very substantial government subsidy and, given the difficulty of the task before them, there is no objection to this. However, care must be taken that this subsidy and control of the data stream not be used in a way that inhibits the formation and profitable operation of a diverse value added industry. At the heart of this problem is clarification of the difference between data and value added products based upon the data as it relates to income generating potential of EOSAT and value added firms. This is still a gray area requiring further clarification. Furthermore it is not certain that the present plan to have EOSAT income derived from data sales and value added firm income derived from value added products can make both EOSAT and a multitude of value added firms profitable. Some other mechanism such as payment to EOSAT of appropriate royalties on value added products may need to be considered.

ISSUE 4

What should the U.S. do if foreign governments subsidize their Landsat-like systems to the degree that it threatens viability of a commercial Landsat operation?

The U.S. must be prepared for this evantuality and have the plans to react to it by some combination of international negotiation and possibly matching subsidies. The situation is not unlike the present problems of pricing between Shuttle and Ariane.

ISSUE 5

How to avoid U.S. government agency value added activities from interfering with the development of a vigorous private value added industry?

At present, and for some time to come, the largest single potential market segment for Landsat data and value added products is U.S. Federal Government agencies. If these agencies perform all or most of their value added functions internally within those agencies it will significantly inhibit development of a vigorous value added industry. These agencies need to be encouraged to employ private sources of such services wherever possible.

ISSUE 6

NASA/NOAA role in performing research and development on new insiruments and applications in support of a commercial Landsat system.

Until the Landsat commercial market becomes developed for beyond what it is at present, revenues will not support the research and development necessary to continue advancing the technologies. Therefore, for sometime to come this R&D responsibility must be assumed by the U.S. Government and in particular by NASA and NOAA much as it has been done with regard to space communications and weather satellites. As Space Station begins to consume larger portions of the NASA budget, care must be exercised to preserve the required Remote Sensing R&D.

ISSUE 7

Competition to commercial Landsat from free data generated by government experimental systems.

Through much of previous Landsat history, while it was an experimental system, substantial commercial use of the resultant data has been made of the government subsidized data. If this continues with data from future experimental systems it will inhibit development of a commercial Landsat. Therefore means of avoiding such interference with commercial Landsat development must be devised.

ISSUE 8

Standardization, quality control and orbit coordination with comparable foreign systems.

As U.S. and foreign Landsat type systems develop it will be in the common interest to standardized data types and quality control and to coordinate orbits to maximize useful coverage, particularly for renewable resource applications. Just as are communications and meteorological satellite systems, Landsat type systems are fundamentally global in nature. Therefore global coordination is in everyone's interest.

These eight issues are some of the more important problems we must all grapple with as we proceed with Landsat commercialization. They are all soluable and the benefits inherent in a successful Landsat system are well worth the effort.

Senator GORTON. Mr. Holter, we are going to have to interrupt you at this point. We have another vote taking place, and Senator Pressler was out of the room during the testimony of Mr. Williams. He has several questions for him, only one of which he wished to ask him on the record.

So I will start out to vote and hope to get back soon. If Mr. Holter could come up and Senator Pressler can ask him that question—

Senator PRESSLER. Mr. Williams, if Mr. Williams could come up. If we could make a chair for him, I will ask him a question or two.

By the way, while you are coming up, I might say to Mr. Spriesterbach that Senator Grassley said to say hello this morning. So I pass that on.

Mr. Williams, thank you for returning. Do you support the university consortium idea, and in particular do you think we can develop adequate guidelines to ensure that data made available for research can be restricted so as not to interfere with commercial sales?

CHARLES P. WILLIAMS—Resumed

Mr. WILLIAMS. The basic answer is yes, we support the university program. The program that we have at EOSAT is very similar to that which was developed many years ago by NASA. It is called the Center of Excellence Program. It deals with research institutions and academia as such that do basic sponsored and unsponsored research, or sponsored on their own behalf rather than through government auspices.

We feel that it is absolutely necessary in order to foster future developments, to foster future understanding, and also to foster guidelines for instrumentation that must be developed for the out years. Part of the activity that is going on right now will help EOSAT not only develop guidelines for the advanced instrumentation, but by the same token develop an understanding of what is required by the user community and also what can be implemented utilizing the latest state of the art equipment for processing or image processing systems.

So we fully support it.

Senator PRESSLER. Would EOSAT be willing to provide data to the government archive at cost if you were convinced that it will be strictly limited for research purposes?

Mr. WILLIAMS. As part of our basic policy EOSAT, along with NOAA, has discussed a program whereby we can provide data to the Federal archive for research purposes. We are reviewing the plan with NOAA and also with EROS. We have discussed it with Dr. Watkins and we are looking towards finalizing some form of a plan to better understand the Federal data and archive needs.

We at EOSAT have not seen the guideline plan for the Federal data archive yet, so we are unable to comment on that. Senator Gorton asked the same or similar question.

Senator PRESSLER. Yes, I know you are working on the plan and you have not seen their guidelines. But from your point of view, would it be acceptable to you, would you be willing to provide the data to the government archive at cost if you are convinced it will be strictly limited for research purposes?

Mr. WILLIAMS. If it can be limited for research purposes and not interfere with basic image processing that must be done for commercial applications.

Senator PRESSLER. What is that again?

Mr. WILLIAMS. If it does not interfere with the basic production of image processing data for the commercial market. If we have to interrupt the basic commercial market, we would have to look at it from another point of view. If it is strictly on a basis where it is an as-available and as-required by EROS in this context, then, yes, it would not provide any problem to us.

So I think we still have to understand the detailed guidelines and the other implications or impacts which may occur by the request for data. There are mechanics to be worked out.

Senator PRESSLER. I must go and vote. But anything you can submit in writing that would clarify the standard that you are seeking. I know you have not seen the government's proposal, but the standard that would be acceptable to you on this issue, this is something I am very interested in and want to work with you. But I do want to be assured that the public interest here is protected.

Mr. WILLIAMS. Yes. I think that would be more appropriate, that we do provide a written statement relative to the detailed position.

Senator PRESSLER. Good. Thank you.

Now I am going to recess the hearing for a few minutes while I go vote, if I can still make it.

[Recess.]

Senator GORTON. Mr. Murphree, we are ready for you.

Mr. MURPHREE. Thank you, Mr. Chairman. I want to update you with a new private corporation that has been established within the State of Mississippi, the Institute for Technology Development—short name, ITD. It is a private nonprofit corporation established to develop technology and to exploit it for commercial purposes, totally applications oriented.

What makes it somewhat unique, the initial seed funding to establish it came from the private sector within Mississippi, the State of Mississippi, the U.S. Department of Commerce and NASA.

Recognizing the potential for new commercial ventures in space remote sensing, ITD, in partnership with NASA, has established a National Center for the Commercial Development of Space Remote Sensing. This center will be co-located with NASA's National Space Technology Laboratory in Bay St. Louis, MI. It will be eventually housed in the state of the art equipped new facility that the State is building to put on the NASA site to house its private corporation, and this proximity to the Earth Resources Lab of NASA which is the applications remote sensing arm of NASA, will facilitate access to NASA's research program and enhance the commercial development of experimental results in remote sensing.

Previous U.S. Government efforts to convert experimental technology's operational capabilities have designed a process that for the most part has been technology-driven. In other words, it has been a technology push and not a market pull program.

Our remote sensing payloads to date have been designed and developed by the Government to meet primarily Government program objectives. Thus, the commercial market demand has not been a driving force in the remote sensing activity to date.

The establishment of new business ventures are severely limited because of the needs, such as enhanced analytical techniques or new data bases or new software to convert space-acquired data into information needed by these commercial value-added companies.

Needs go all the way to access to skilled personnel, state of the art facilities and equipment, and early access to data. This reason the Center was established, was to address these needs. The Center has put together a partnership between industries, universities, NASA and other government organizations to support this commercialization process, everywhere from developing new software packages, developing new hardware packages, testing value-added concepts by pilot projects, and also training and education.

The Center presently includes 13 industrial partners and a network of 14 affiliated universities throughout 12 States in the country. Business and commercial needs are the driving force of the Center's program. The initial industrial partners represent all three sectors of space remote sensing business: data suppliers, information users and suppliers, and the software and hardware suppliers.

The initial funding for the Center is $1 million per year for the next 5 years from NASA, and the State and the private sector is putting an equivalent of about $2 to $3½million per year. We intend to expend about $17½ million over the next 5 years in this commercial thrust to support the small value-added businesses of America.

We see the implementation of this Center for commercial development to do a number of things:

1. To really put together a coordinated effort in applications R&D aimed at commercialization, tying together the various government arms, university arms, and industries nationwide.

2. To leverage returns of both present and future enterprises by an aggressive research and development activity program which supports these enterprises throughout the country.

3. Aggressive pursue commercial development in R&D programs, and work with the various corporations which you have heard from today to see that we maintain in this country leadership in the very significant area of technology.

Thank you.

[The statement follows:]

STATEMENT OF DAVID L. MURPHREE, PRESIDENT, INSTITUTE FOR TECHNOLOGY DEVELOPMENT

INTRODUCTION

David L. Murphree, President and Chief Executive Officer of the Institute for Technology Development, with headquarters in Jackson, Mississippi, is pleased to submit this testimony to the Subcommittee on Science, Technology and Space of the Senate Committee on Commerce, Science and Transportation for the oversight hearing on implementation of the Land Remote Sensing Commercialization Act of 1984 (Public Law 98-365).

The Institute for Technology Development (ITD) is a private, non-profit corporation established to conduct and transfer scientific research into useable technology for commercial applications in order to improve the economic development of Mississippi and the Nation. ITD has four principal goals:

- To establish university-affiliated technology development groups to conduct applied research and product development in targeted areas;
- promote the commercialization of selected technologies and enhance the technical capabilities of the private sector;
- promote technology-based economic development, thereby strengthening the international competitive position of U. S. industry.
- be self-supporting in four years.

To secure the achievement of the principal goals, and operating under the established premise that private industry has the paramount expertise in product commercialization, the ITD Charter requires that the majority of the ITD Board of Directors be from the private sector. This 15 member Board, composed of corporate executives, university presidents and state officials responsible for economic development, is thus structured to ensure that this partnership for advanced technology commercialization results in profit making endeavors for the benefit of the Nation.

Recognizing the potential for new commercial ventures in space remote sensing and in keeping with its mission, ITD has established the National Center for the Commercial Development of Space Remote Sensing (the Center).

The Center is collocated with NASA's National Space Technology Laboratory (NSTL) in Bay St. Louis, Mississippi. It will eventually be housed in a state-of-the-art equipped new $4 million facility provided by the state of Mississippi expressly for this work adjacent to NSTL's Earth Resources Laboratory (ERL). This proximity to ERL will facilitate access to NASA's research programs and enhance the commercial development of research results. The Center anticipates a close working relationship with the Jet Propulsion Laboratory and other NASA facilities such as the Ames Research Center.

BACKGROUND

The historic Land Remote Sensing Commercialization Act of 1984 provides the foundation for a new U. S. remote sensing industry. Further, current Administration policy encourages domestic commercial exploitation of space capabilities, technology and systems for national benefit. This new consensus gives rise to greater potential for commercial activity in civilian remote sensing.

Since its inception, NASA has developed the civilian space technology to achieve and preserve world leadership in space activities for peaceful purposes. In the area of remote sensing, NASA continues to advance technological capabilities for earth and ocean observations. To date, the U. S. investment has achieved a level of capability that can now begin to address business needs for improved information on the earth's natural resources. While still high-risk because of near term uncertainties regarding data availability, the evolution of technology and improved understanding of information requirements have stimulated significant interest and resource investment by the international community.

Requirements for monitoring and assessing the condition of earth's resources which affect the very quality of life - from the production of food and fiber to the discovery and exploitation of oil and mineral resources - are complex and expensive to implement. Past technology development programs in this country have been sponsored by the federal government and, as government support to carry on operational earth and ocean missions declines, other foreign governments are planning major initiatives. These initiatives by the French, Japanese, Germans, Canadians and Brazilians take advantage of U.S.-developed technology. They are based on heavy subsidies to foreign industry by their respective governments, thus placing U.S. industry at a competitive disadvantage.

Previous U. S. Government efforts to convert experimental technology to operational capabilities define a process that for the most part has been technology-driven. Remote sensing payloads to date have been designed and developed by the government to meet primarily government program objectives. Thus, commercial market demand has not been a driving force in remote sensing programs. At the same time, significant application research and development and technology transfer have occurred with government and university users. While these activities have stopped far short of what is really needed by business and industrial users, software companies that focus on image analysis and information system markets, as well as a few other remote sensing related businesses, have been established. However, their growth and the establishment of new business ventures particularly in other sectors are severely limited because of the need for:

- Enhanced analytical techniques , databases and software to convert the space-acquired data into information needed by the commercial market place,
- New commercially driven sensor concepts and data handling methodologies,
- Increased awareness among business and industry of the potential of remote sensing as an information source,
- Access to skilled personnel and state-of-the-art facilities and equipment, and
- Early access to government R&D results.

INDUSTRY, UNIVERSITY AND GOVERNMENT PARTNERS

To address these needs, the Center has established a partnership between industries, universities, NASA, and other government organizations to support the commercialization process. This process requires: development of new software packages; testing by means of pilot projects; near term application development with existing technologies; long term research and development to advance the state-of-the-art and develop commercially responsive technology; outreach, training and education to increase awareness; and business planning - including market analysis and capital formation - to support new business ventures.

The Center includes industrial partners and a network of affiliated universities, with business and commercial needs driving the Center's programs. The initial industrial partners represent all three sectors of space remote sensing business: data suppliers, information users and suppliers and software and hardware system suppliers. The affiliated universities located in 12 states, represent the most competent research organizations in the areas defined by industry for high priority attention. Additional research institutions will be added as new research capabilities are needed support business and industry requirements.

The Center has brought together a team composed of very capable and experienced industry, university and government partners. These partners which have either signed a memorandum of understanding with ITD which commits resources to the Center or have indicated their willingness to support or cooperate with the Center include:

Industry

Data Suppliers: EOSAT, Geospectra, Space Services, Inc.

Information Users and Suppliers: DESTEK Group, Ducks Unlimited, Hutson Chemical, Industrial Development Council, Mead Corporation

Software and Hardware Systems: Cray Research, ERDAS, Intergraph, Synercom

Universities

Jackson State University, Kansas University, Louisiana State University, Michigan State University, Mississippi State University, Murray State University, Oklahoma State University, Pennsylvania State University, Texas A&M University, University of California/Santa Barbara, University of Delaware, University of Mississippi, University of Missouri and the University of Southern Mississippi

Government

Naval Ocean Research and Development Activity
NASA/NSTL
U. S. Army Corps of Engineers/Waterways Experiment Station
Mississippi Mineral Resources Institute

BUDGET, BENEFITS AND EXPECTED RESULTS

The projected 5-year financial support and source of operational funds are presented in Figure 1. For the first year operational activities totaling $2.74 million, ITD has received $1 million from NASA or 36.5% of the total operational budget. ITD is providing $500K ($250 plus $250 is waived overhead and fees), industrial in-kind support is $810K and the state of Mississippi is providing $430K ($400K as the planning phase of the $4 million house the Center). Thus, for the first year, each NASA dollar leverages an additional 1.74 dollars from national private businesses and state funds. It should be noted that this does not include the construction cost of the Center's $4 million facility.

With the Center's strong management, its highly competent industry, university and government team, and its aggressive, well conceived commercial development program, it is anticipated that the Center will become self-sustaining after four years.

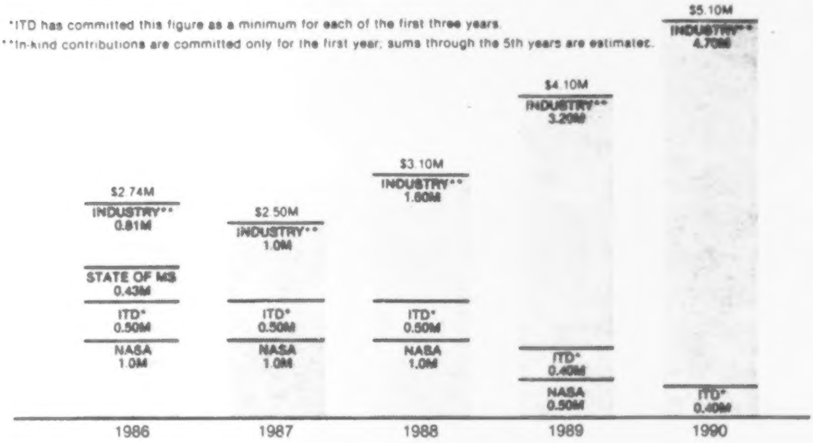
The Center's long term business development program will greatly benefit the food and fiber industries, and oil, gas and mineral industries in the United States through increased productivity. With a very modest goal of increasing the overall productivity by 1%, the annual savings to these organizations could be huge. For instance, the amount of business in the United States directly related to crop, livestock, fiber, forest and fish production, as well as agricultural chemicals, fertilizers, equipment, transportation, warehousing and services, is over $160 billion per year. With the Center's projected investment of $17.5 million over the next five years, a 1% increase in productivity could result in an $1.6 billion annual savings to these industries.

The implementation of the National Center for the Commercial Development of Space Remote Sensing will result in:

o A thorough assessment of remote sensing potential as a commercial business,
o An expanded awareness of the advantages of space and an increase in space ventures,
o Leveraged returns for future enterprises by aggressive research and development activities,
o Effective interaction with NASA in developing transportation, space laboratory and space platform concepts for the benefits of American causes

o Profit making from the very beginning, with risks offset by the huge potential inherent in aggressive commercial development and R&D programs, and

o Maintenance of U.S. leadership in a significant international arena.



*ITD has committed this figure as a minimum for each of the first three years.

**In-kind contributions are committed only for the first year; sums through the 5th years are estimates.

FIGURE 1. Projected 5-Year Financial Support and Source of Operational Funds

Senator GORTON. I thank you very much.

All of you have been here all morning, as a matter of fact at this point, and have listened to comments from Federal agencies and from EOSAT on the availability of data for research purposes.

This is an open-ended question and I would be happy to have the comments that any of you would care to make, the reactions any of you would have, briefly, to what has been stated about data availability by those earlier witnesses.

Does anyone want to take a crack at that?

Dr. Spriestersbach?

Dr. SPRIESTERSBACH. Well, it is just to reiterate what has been said, the importance of access on a timely basis, because of technology that we all know is in such a revolutionary state and is moving so rapidly that time becomes a very critical element. And then the whole issue of lost opportunity.

Senator GORTON. Were you encouraged by what they said earlier with respect to getting that data on a timely basis?

Dr. SPRIESTERSBACH. Well, there are a lot of technical and difficult considerations here. I am sort of coming at it as a lay person. It seemed to me the attitude was very appropriate, whether on a given Tuesday we can work out all those problems, we will have to wait and see. I thought the attitude was very positive.

Senator GORTON. Dr. Arvidson.

Dr. Arvidson. I think it is important to reiterate the requirements of the research community. They need to get ahold of data, ahold of documentation. They need to be able to share data and publish results. Nothing I heard this morning is discouraging with regard to LANDSAT, if the funds are available in this nondiscriminatory law to enable those kinds of requirements to be met.

I am still concerned about the next decade and the separation of research or experimental systems from commercial systems. In the next decade we will have more data, and we will have a need to share data amongst more groups, hopefully because there will be a larger research community. We can get into serious problems associated with data costs and licensing restraints.

Senator Gorton. Mr. Holter.

Mr. Holter. Well, I am encouraged by comments with regard to release of EOSAT-generated data for research. I think that problem is soluble. I think the community is aimed at solving it.

There is another research data issue that is more complex and may be more difficult to solve. There are at present a number of research instruments in orbit—the coastal zone color scanner, AVHRR somebody referred to earlier. In fact, data from these instruments are being used in an applied commercial sense in conjunction with LANDSAT at the moment. And they have disadvantages and certain advantages.

The two I mentioned have coarser resolution, but they come by much more frequently and so it is easier to countermeasure the cloud cover with them. They see larger areas. And so in the whole concept of multistate sampling, these things have commercial uses, and we have coming downstream the imaging spectrometer and a number of other NASA instruments which are research instruments, but as a matter of fact, their utility, their value, may be at least equal in the commercial business.

So, in short, I see a problem here. We have taken only the first step in commercialization with only one of the sensors. There are a number of others here, and how we transition these or use these during the commercialization phase so that we don't damage, but rather amplify the value of EOSAT, is a problem we are going to have to face up to.

Senator Gorton. Is it possible to designate the particular data products as being research or commercial, to distinguish between the two, and to provide different terms of data availability on the basis of that designation?

Mr. Holter. No. Data does not have any label, "research," applied. It becomes research or applied depending upon how you use it, and any data can be used for either purpose. So there is no easy solution to it in that sense.

Senator Gorton. Anybody else? Dr. Henderson?

Dr. Henderson. I would like to just clarify and support what Mike is saying; that we, the GEOSAT Committee people whom I represent, in a sense are precluded perhaps because they represent corporations who want to evaluate and try out or experiment with new data systems.

We are particularly concerned, for example, with the implications of NASA's current interpretations for sharing experimental data as it might apply to all of the long term experimental programs being proposed under this so-called Unified National Plan.

We think it is vital that our industrial research community—we have researchers of equal par with universities and with government researchers—be allowed to be part of the research and evaluation process for new data systems.

Our kind of evaluation, of course, in some areas is done to determine if we can use the data in an applied way. That is a vital step in the—as Mike says—to support the EOSAT Corporations and other commercial ventures, we need to evaluate new data to see if it is of any use to us to use or purchase and use in a commercial way. Evaluation and commercial use are separate.

Our interests in access to experimental data is not to use it in a commercially ongoing operational manner, any more than anybody else. We simply want to have access to these data, try it out, and demonstrate its utility. We are willing to find ways to report on the results of those evaluations back to Government and to the commercial community.

It is our interest and everybody's interest that we as users have a chance to try out this data.

Senator GORTON. Is the commercialization process under way for the Landsat system likely to cause future sensor development to be market-driven rather than technology-driven? And if so, what kind of application or what kind of effect is that likely to have?

Dr. ARVIDSON. It is my understanding that most of the efforts funded by NASA, at least over the past couple of years and including the plans for the next several years, have instruments being driven largely by science objectives rather than commercialization objectives.

It is my understanding that commercialization has not driven instrument design or deployment yet.

Senator GORTON. Mr. Holter?

Mr. HOLTER. As a technologist, I have great confidence that technologists will get their chance to develop their technology. I agree withyour previous speaker that we are overbalanced at the moment in that way and the corrective action that is needed is to acquire more applied commercial interest in what gets developed.

I don't think we have to worry about the technologists doing what they are interested in.

Senator GORTON. Tell me whether or not you think Landsat commercialization will lead to broader utilization of Landsat data resulting from private marketing, or to lesser utilization of the data because of the inability of researchers to gain appropriate access?

Mr. HOLTER. Oh, I have no doubt in my mind that the Landat commercialization will in due course lead to much wider use of the data for both commercial and research purposes.

Senator GORTON. Mr. Murphree, do you have a thought on that subject?

Mr. MURPHREE. I was just going to comment on the previous question first; that the role we will attempt to be playing is to see that these sensors are market-driven type sensors, not just technology-driven type sensors. The role we are going to play is working with those users, the value-added people, and what do they really need to service and sell their product—which is really a commercial market pull situation.

There is some concern from some of these small entrepreneur companies that with the data being in the hands of now the private sector, what is the cost going to be? Is it really going to be a cost that may be—that they can afford? But that is just an issue.

Senator GORTON. Do any of the rest of you have any final comments you would like to make?

Dr. Henderson?

Dr. HENDERSON. I think that the basic science drive for development of new technologies such as the approach of Shelby Tilford and others at NASA is a proper one for Government to do. I think the drive for commercially-driven systems obviously will follow in the effort to commercialize and carry the development in the private sector.

The key issue is how do we form a link for management decisions between what basic research should be done and also what is the area that should be developed commercially. And in my testimony, I have proposed that some kind of an ongoing forum be considered by Congress and the government to make that mix—to bridge that gap.

Senator GORTON. Thank you.

Senator Pressler?

Senator PRESSLER. I think my questions have been covered, but I will just ask this one. Dr. Spriestersbach and Dr. Arvidson, how important is archive access to university research in remote sensing? And in a more broad sense, is the direction we are heading with the archives and the agreement between private contractor and the Government acceptable, and will the archives be available enough to universities and to the public interests, so to speak?

Dr. SPRIESTERSBACH. I will let my colleague really answer that substantively because he has got the background that enables him to do that.

But on the basis of the very strong interest of my colleagues at my institution—and I am sure that is replicated in a whole variety of similar institutions—that we are dealing here with a body of data that is of great keen interest to them; then obviously people like myself try to do everything we can to make sure that they can access it in a timely and cost-effective fashion.

So he will have to answer the particulars.

Dr. ARVIDSON. Thank you.

The idea of an archive with documentation is the appropriate idea. I think, on the other hand, the concept in terms of implementation that we have heard this morning, is an archive that would have worked for the 1960s. The technology today, and especially over the next several years, will really allow an archive to be a central vault. You can directly involve the geographically distributed science community directly through telecommunications.

In my opinion, there is no need to co-locate physically archive data and people. That is certainly going to be the case in the next decade. If you really want to involve the science community and the university community, connect them together through telecommunications.

Senator PRESSLER. With technological communications.

I will address this question to the entire panel. Could you address the need for and the benefits of strong university involvement in an R&D program, specifically commenting on the desirability of a university consortium and any other roles in which universities could participate?

Dr. ARVIDSON. R&D and university involvement I think is key to the success of future endeavors in remote sensing, understanding the earth as a planet, and eventually commercialization of the appropriate components of remote sensing systems that produce data.

I think that such an involvement is important. Students come from university R&D involvement; they eventually will go out and fully utilize the new systems. So it is important.

Let's consider the university consortium in terms of the problems that we might be addressing by having a consortium. I think to have a healthy R&D program with university involvement, you need a healthy research base at the universities, you need access to data, you need to be able to share data.

The consortium is one possible way to implement those requirements. That seems to me though, frankly, to be kind of a top-down approach, and what we need first is a grounds-up approach where we establish strong university research groups at a number of universities.

Dr. SPRIESTERSBACH. I couldn't agree with you more. Somebody commented earlier this morning that there are examples of very successful consortia, and there are others that haven't worked at all.

People will consort if there is some reason to consort. There is nothing mystical or magic about consortia. And where there are common interests that are clearly identified and can be served only by consorting, people will want to consort. So we have to identify these common intersts sort of at the ground base level and then build from there.

So I just add support to the previous comments.

Mr. HOLTER. It seems to me that the university consortia that I know of are established because usually there is required some very large expensive facility that you cannot replicate at a number of universities. There is a university consortium to operate a large astronomical telescope; the Lunar Science Laboratory at Houston was operated that way. Big accelerators tend to do that.

I think organize consortia because there are expensive facilities that you cannot replicate, and if that element is not present, there does not seem to be any necessary advantage to having a consortium.

Dr. SPRIESTERSBACH. Well, there is another reason that you consort, and that is because you have to have a size of human resources adequate to do particular jobs. Our institution happens to be a member of a very successful eight-university consortium where we simply do not have the pool of human resources, except as we combine them to do a particular task.

It may be—and I defer to my colleagues—that there are areas of intellectual activity here that could be advanced by pooling our knowledge and stimulating each other by a very vigorous interaction. I don't know if that is the case here.

Dr. ARVIDSON. I still maintain that we first have to develop those intellectual pools to a greater extent than we have in the past.

Dr. MURPHREE. I like to look at this from a different viewpoint. I come from the University of Alabama. I have been involved in research for many many years. And the way I am trying to view remote sensing right now is the commercial process, the commercial thrust.

Universities are very very capable in basic research, but if the research program is not maybe driven by industrial requirements, it may not really further too great the commercialization process. As we say in Mississippi, you can make the best dog food in the world, but if the dog doesn't eat it, it is not going commercialize.

So it has to have this industrial thrust to give some guidance to consortium research.

Dr. HENDERSON. I would just like to add a different viewpoint altogether. Our concerns in what happens to research and development of remote sensing is that as it passes from —well, let me put it this way; the question is, who is going to do the basic applications R&D?

And as it passes through the commercialization process and changing rolls take place, we have been trying to look at mechanisms for greater cooperation between industry, our user community, companies such as the EOSAT and others, and academia and government.

It seems academia in that three-part system seeks funds from either Government or industry. In our case, the companies represented in the GEOSAT Committee are taking a serious look at other mechanisms or how mechanisms could be encouraged to provide more cooperative funding of applied research for remote sensing.

Consortias can be fun; that is one reason for getting together. We had a lot of fun with this 40-company effort with NASA to put together this test case program. I cannot imagine any one company even beginning to try to tackle that job by themselves, and I cannot imagine NASA having done it without our support. And, by the way, we had some universities represented.

So we are looking for cooperative research mechanisms to bring in more funding, clearly in support of academic research, especially in the area of applications.

Senator Gorton. Thank you all very much. We appreciate both your patience and your wisdom.

We are adjourned.

[Whereupon, at 12:42 p.m., the hearing was adjourned.

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